GUIDELINES FOR THE MANAGEMENT OF COMMON PAEDIATRIC DISEASES AND EMERGENCIES

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Admission and Discharge Policies for the Pediatric Intensive Care Unit

ADMISSION CRITERIA

Age

- PICU will care for patients require intensive care from one month until 15 years old
- Patients outside these general limits require discussion with the PICU consultant.

Respiratory System

Patients with severe or potentially lifethreatening pulmonary or airway disease. Conditions include, but are not limited to:

1 Endotracheal intubation or potential need for emergency endotracheal intubation and mechanical ventilation, regardless of etiology;
2 Rapidly progressive pulmonary, lower or upper airway, disease of high severity with risk of progression to respiratory failure and/or total obstruction;
3 High supplemental oxygen requirement ($\text{Fio}_2 \geq 0.5$), regardless of etiology;
4 Newly placed tracheostomy with or without the need for MV
5 Acute barotrauma compromising the upper or lower airway;

Cardiovascular System

Patients with severe, life threatening or unstable cardiovascular disease.
Conditions include, but are not limited to:

1 Shock;
2 Postcardiopulmonary resuscitation;
3 Lifethreatening dysrhythmias;
4 Unstable congestive HF, with or without need for mechanical ventilation;
5 Congenital heart disease with unstable cardiorespiratory status;
6 After highrisk cardiovascular and intrathoracic procedures;
7 Need for continuous monitoring of arterial or central venous pressures;
8 Need for temporary cardiac pacing;

Neurologic

Patients with actual or potential lifethreatening or unstable neurologic disease.
Conditions include, but are not limited to:

1 Seizures, unresponsive to therapy or requiring continuous infusion of anticonvulsive agents;
2 Acutely and severely altered sensorium where neurologic deterioration or depression is likely or unpredictable, or coma with the potential for airway compromise;
3 After neurosurgical procedures requiring invasive monitoring;
4 Acute inflammation or infections of the spinal cord, meninges, or brain with neurologic depression, metabolic and hormonal abnormalities, and respiratory or hemodynamic compromise or the possibility of increased ICT;
5 Head trauma with increased intracranial pressure;
6 Preoperative neurosurgical conditions with neurologic deterioration;
7 Progressive neuromuscular dysfunction with or without altered sensorium requiring cardiovascular monitoring and/or respiratory support;
8 Spinal cord compression or impending compression;
9 Placement of external ventricular drainage device.

Hematology/Oncology

Patients with lifethreatening or unstable hematologic or oncologic disease or active lifethreatening bleeding. Conditions include, but are not limited to:

1. Exchange transfusions;
2. Plasmapheresis or leukopheresis with unstable clinical condition;
3. Severe coagulopathy;
4. Severe anemia (Hb< 5gm/dl) resulting in hemodynamic and/or respiratory compromise;
5. Severe complications of sickle cell crisis, such as neurologic changes, acute chest syndrome, or aplastic anemia with hemodynamic instability;
6. Initiation of chemotherapy with anticipated tumor lysis syndrome;
7. Tumors or masses compressing or threatening to compress vital vessels, organs, or airway.

Endocrine/Metabolic

Patients with lifethreatening or unstable endocrine or metabolic disease. Conditions include, but are not limited to:

1. Severe diabetic ketoacidosis (PH ≤7.1)
2. Other severe electrolyte abnormalities, such as:
    - Hyperkalemia, requiring cardiac monitoring
    - Severe hyper - hyponatremia
    - Severe Hyper- hypocalcemia
    - Hypoor hyperglycemia requiring intensive monitoring
    - Severe metabolic acidosis requiring intensive monitoring, or complex intervention
    - Complex intervention required to maintain fluid balance
3. Inborn errors of metabolism with acute deterioration requiring respiratory support, acute dialysis, hemoperfusion, management of intracranial hypertension, or inotropic support.

Gastrointestinal

Patients with life threatening or unstable gastrointestinal disease. Conditions include, but are not limited to:

1. Severe acute gastrointestinal bleeding leading to hemodynamic or respiratory instability;
2. After emergency endoscopy for removal of foreign bodies;
3. Acute hepatic failure leading to coma, hemodynamic, or respiratory instability.
4. Severe dehydration not respond to first line shock therapy.

Renal System

Patients with life threatening or unstable renal disease. Conditions include, but are not limited to:

1. Renal failure;
2. Requirement for acute hemodialysis, peritoneal dialysis, or other continuous renal replacement therapies in the unstable patient;
3. Acute rhabdomyolysis with renal insufficiency.

Multisystem and Other

Patients with life threatening or unstable multisystem disease. Conditions include, but are not limited to:

1. Toxic ingestions and drug overdose with potential acute decompensation of major organ systems;
2. Multiple organ dysfunction syndrome;
3. Suspected or documented malignant hyperthermia;
4. Electrical or other household or environmental (eg, lightning) injuries;
5. Burns covering .10% of body surface (institutions with burn units only; institutions without such units will have transfer policy to cover such patients).

Special Intensive Technologic Needs

Conditions that necessitate the application of special technologic needs, monitoring, complex intervention, or treatment including medications associated with the disease that exceed individual patient care unit policy limitations.

DISCHARGE / TRANSFER CRITERIA

Patients in the PICU will be evaluated and considered for discharge based on the reversal of the disease process or resolution of the unstable physiologic condition that prompted admission to the unit, and it is determined that the need for complex intervention exceeding general patient care unit capabilities is no longer needed.

Transfer/discharge will be based on the following criteria:

1 Stable hemodynamic parameters;
2 Stable respiratory status (patient extubated with stable arterial blood gases) and airway patency;
3 Minimal oxygen requirements that do not exceed patient care unit guidelines;
4 IV inotropic support, vasodilators, and antiarrhythmic drugs are no longer required.
5 Cardiac dysrhythmias are controlled;
6 Intracranial pressure monitoring equipment has been removed;
7 Neurologic stability with control of seizures;
8 Removal of all hemodynamic monitoring catheters;
9 Routine peritoneal or hemodialysis with resolution of critical illness.
10 Patients with mature artificial airways (tracheostomies) who no longer require excessive suctioning;
11 The health care team and the patient’s family, after careful assessment, determine that there is no benefit in keeping the child in the PICU or that the course of treatment is medically futile.

Cardiopulmonary Resuscitation (CPR)

A sudden cardiac arrest is uncommon in children. Cardiac arrest is usually the terminal event of progressive respiratory failure or shock.

1. Airway

- Mild neck extension is needed (child head & occiput are proportionately large, causing neck flexion).
- Can use a folded towel placed under the neck and shoulder.
- Open the airway by head tilt chin lift method. If you suspect a cervical injury, open the airway using a jaw thrust without head tilt.
- Clear airway from secretions, vomitus and remove foreign bodies.
- Oropharyngeal and nasopharyngeal airways for maintaining an open airway.
    - Oropharyngeal (in unconscious patient; ie, with no gag reflex)
      size: distance from the central incisors to the angle of the mandible.
    - Nasopharyngeal (better tolerated than oral airway by patients who are not deeply unconscious)
      size: distance from the tip of the nose to the tragus of the ear.

2. Breathing

☐ Use 100% oxygen during resuscitation.

- **Bag Mask Ventilation** can be as effective as ETT.
  - Use a selfinflating bag with a volume of 450 to 500 ml.
  - Maintain oxygen flow of 15 L/min into a reservoir attached to a bag.
  - The mask should fit over the mouth and nose to provide a tight seal and avoid any air leakage.

☐

- Ventilation through an **endotracheal tube** (ETT) size: (for children 1 to 10 years of age)

ETT internal diameter (mm ID) = (age in yrs/4) + 4

- Laryngeal Mask Airway (LMA)
  - when endotracheal intubation is not possible, the LMA is an acceptable adjunct for experienced providers.

To minimize gastric inflation

- Avoid excessive peak inspiratory pressures (eg, ventilate slowly and watch chest rise, deliver only the volume needed to produce visible chest rise).
- Apply cricoid pressure to obstruct the esophagus.
- Pass NG tube after you intubate because a gastric tube interferes with the gastroesophageal sphincter, allowing possible regurgitation.

Excessive ventilation is detrimental because it:

- Impedes venous return and therefore decreases cardiac output, cerebral blood flow, and coronary perfusion by increasing intrathoracic pressure.
- Causes air trapping and barotraumas in patients with small airway obstruction.
- Increases the risk of regurgitation and aspiration.

3. Circulation

☐ Check pulse (brachial artery in infants – carotid/femoral artery in children).

☐ Start cardiac compressions when heart rate <60 beats/min with signs of poor perfusion.

Characteristics of good chest compressions:

- "Push fast" at a rate of 100 compressions/min.
- "Push hard" to depress the chest 1/3 to 1/2 of the anterior-posterior diameter of the chest.
- Release completely to allow the chest to fully recoil after each compression.
- Minimize interruptions in compressions.

Recommended chest compression ventilation ratio:

- One rescuer: give cycles of 30compressions:2breaths.
- Two rescuers: give cycles of 15compressions:2breaths.
- When an advanced airway is established (eg, ETT or LMA).
  1. Give continuous chest compressions without pauses for breaths.
  2. Give 8 to 10 breaths/minute.
  3. Check rhythm every 2 minutes and change the compressor role to prevent fatigue and deterioration in quality and rate of chest compressions.
  4. The switch should be done in less than 5 seconds to minimize interruption in chest compression.

if the pulses are present but no breathing, give 12 to 20 breaths per minute (1 breath every 3 to 5 seconds).

Cardiac compressions	Infant	Child
Rate/min	100	100
Depth	1/3 of A-P chest diameter	1/3 to 1/2 of A-P chest diameter
Site	Lower half of the sternum not over the xiphoid (below intermammary line)	Lower half of the sternum not over the xiphoid
Technique	2 fingers technique. Fig.1 OR 2 thumb-encircling hands technique (preferred). Fig.2	heel of one hand or two hands technique

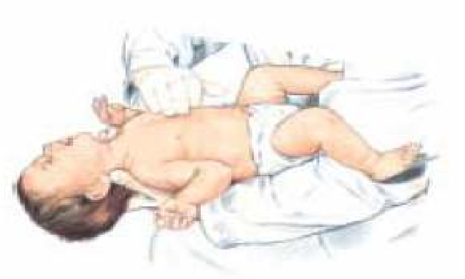


Figure 1. Two-finger chest compression.

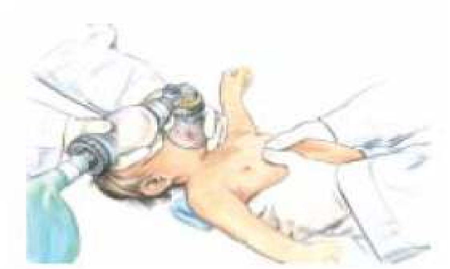


Figure 2. Two thumb-encircling hands chest compression.

Vascular access

- If you cannot achieve reliable access quickly, establish intraosseous (IO) access.

Fluids:

- Use isotonic crystalloid solution to treat shock (20 ml/kg of normal saline as quickly as possible). Repeated boluses may be necessary.

- **Hypotension** is a systolic blood pressure < 5th percentile of normal for age: <60 mm Hg in term neonates.<70 mm Hg in infants<70 mm Hg + (2 x age in yrs) in children 1 to 10 years<90 mm Hg in children >10 years of age.
- Glucose containing fluids are not indicated during CPR unless hypoglycemia is present.

4. Drugs

- Drugs are preferably administered through IV or IO than by ETT.
- If vascular access cannot be established, some drugs can be given via ETT.(“LEAN” Lidocaine, Epinephrine, Atropine, Naloxone). Flush with a minimum of 5ml normal saline followed by 5 assisted manual ventilations. If CPR in progress, stop chest compressions briefly during administration of medications.
- Epinephrine dose in cardiac arrest = 0.01 mg/kg as the first and subsequent IV doses. Routine use of high dose epinephrine (0.1mg/kg) intravascular is not recommended and may be harmful.

Medications to maintain cardiac output and for postresuscitation stabilization

Medication	Dose	Comment
Dobutamine	2-20 μg/kg/min IV/IO‡	Inotrope; vasodilator
Dopamine	2-20 μg/kg/min IV/IO‡	Inotrope; chronotrope; renal and splanchnic vasodilator in low doses; pressor in high dose
Epinephrine	0.1-1 μg/kg/min IV/IO*	Inotrope; chronotrope, vasodilator in low doses; pressor in higher doses
Norepinephrine	0.1-2 μg/kg/min*	Inotrope; vasopressor
Sodium nitroprusside	1-8 μg/kg/min‡	Vasodilator; prepare only in D5W

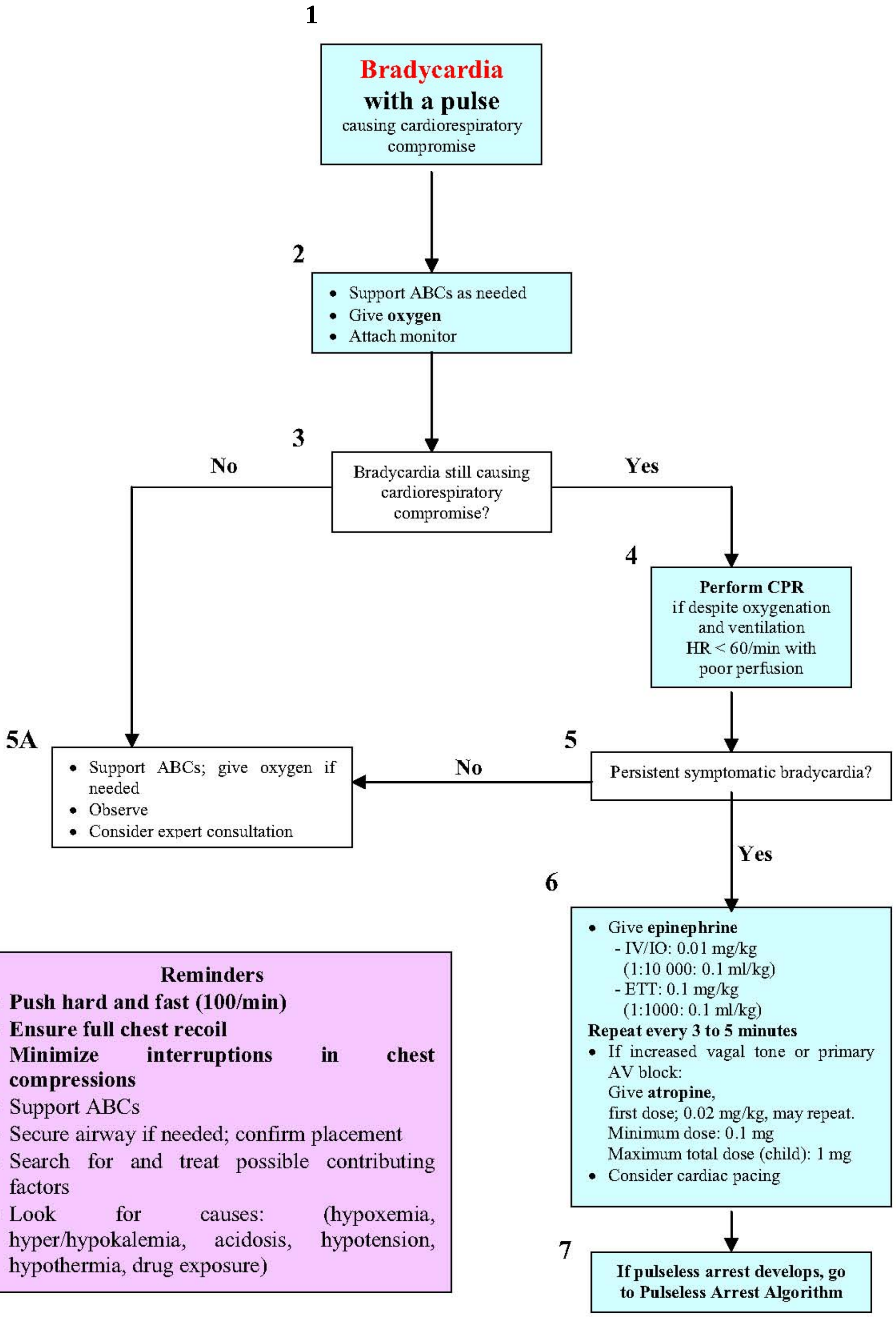
‡ 6 x body weight (in kg) = mg of drug to add to 100 ml D5W
then, an IV rate of 1 ml/h delivers 1 μg/kg/min of drug

* 0.6 x body weight (in kg) = mg of drug to add to 100 ml D5W
then, an IV rate of 1 ml/h delivers 0.1 μg/kg/min of drug

Medications for Pediatric Resuscitation and Arrhythmias

Medication	Dose	Remarks
Adenosine	0.1 mg/kg (max 6 mg) Repeat: 0.2 mg/kg (max 12 mg)	Monitor ECG Rapid IV/IO bolus
Amiodarone	5 mg/kg IV/IO Repeat up to 15 mg/kg Maximum: 300 mg	• Monitor ECG and BP • Adjust administration rate to urgency (give more slowly when perfusing rhythm present) • Use caution when administering with other drugs that prolong QT (consider expert consultation)
Atropine	0.02 mg/kg IV/IO 0.03 mg/kg ET* repeat once if needed minimum dose: 0.1 mg maximum single dose: child 0.5 mg adolescent 1 mg	Higher doses may be used with organophosphate poisoning
Calcium chloride (10%)	20 mg/kg IV/IO (0.2 ml/kg)	Slowly Adult dose: 5 10 ml
Epinephrine	0.01 mg/kg (0.1 ml/kg 1:10 000)IV/IO 0.1 mg/kg (0.1 ml/kg 1:1000) ET* maximum dose: 1 mg IV/IO; 10 mg ET*	May repeat q 3-5 min
Glucose	0.5-1 g/kg IV/IO	D10W: 5-10 ml/kg D25W: 2-4 ml/kg D50W: 1-2 ml/kg
Lidocaine	Bolus: 1 mg/kg IV/IO Maximum dose: 100 mg Infusion: 20-50 μg/kg/min ET*: 2-3 mg	
Magnesium sulfate	25-50 mg/kg IV/IO over 10-20 min; faster in torsades Maximum dose: 2 g	
Naloxone	<5 y or ≤20 kg: 0.1 mg/kg IV/IO/ET* ≥5 y or >20 kg: 2 mg IV/IO/ET*	Use lower doses to reverse respiratory depression associated with therapeutic opioid use (1-15 μg/kg)
Procainamide	15 mg/kg IV/IO over 30-60 min adult dose: 20 mg/min IV infusion up to total maximum dose 17 mg/kg	Monitor ECG and Bp Use caution when administering with other drugs that prolong QT (consider expert consultation)
Sodium bicarbonate	1 mEq/kg/dose IV/IO slowly	After adequate ventilation

* flush with 5 ml of normal saline and follow with 5 ventilations
(IV:intravenous-IO:intraosseous-ET:endotracheal)



1

Bradycardia with a pulse
causing cardiorespiratory compromise

2

- Support ABCs as needed
- Give **oxygen**
- Attach monitor

3

Bradycardia still causing cardiorespiratory compromise?

No → 5A

Yes → 4

4

Perform CPR
if despite oxygenation and ventilation HR < 60/min with poor perfusion

5

Persistent symptomatic bradycardia?

No → 5A

Yes → 6

5A

- Support ABCs; give oxygen if needed
- Observe
- Consider expert consultation

6

- Give **epinephrine**
  - IV/IO: 0.01 mg/kg (1:10 000: 0.1 ml/kg)
  - ETT: 0.1 mg/kg (1:1000: 0.1 ml/kg)

Repeat every 3 to 5 minutes

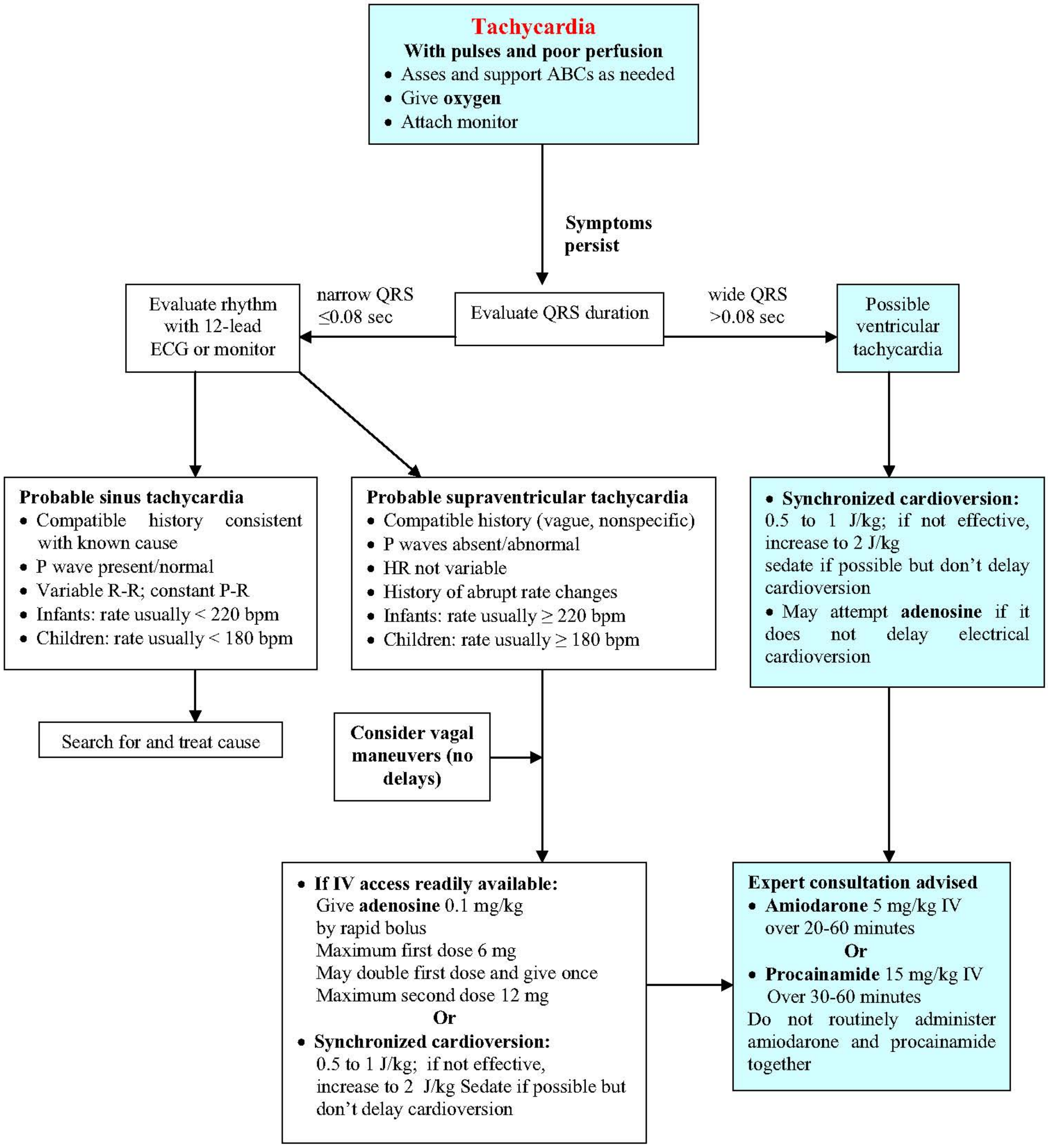
- If increased vagal tone or primary AV block:
  Give **atropine**,
  first dose; 0.02 mg/kg, may repeat.
  Minimum dose: 0.1 mg
  Maximum total dose (child): 1 mg
- Consider cardiac pacing

7

If pulseless arrest develops, go to Pulseless Arrest Algorithm

Reminders

- **Push hard and fast (100/min)**
- **Ensure full chest recoil**
- **Minimize interruptions in chest compressions**
- Support ABCs
- Secure airway if needed; confirm placement
- Search for and treat possible contributing factors
- Look for causes: (hypoxemia, hyper/hypokalemia, acidosis, hypotension, hypothermia, drug exposure)



Tachycardia

With pulses and poor perfusion

- Asses and support ABCs as needed
- Give **oxygen**
- Attach monitor

Evaluate QRS duration

Evaluate rhythm with 12-lead ECG or monitor

Possible ventricular tachycardia

Probable sinus tachycardia

- Compatible history consistent with known cause
- P wave present/normal
- Variable R-R; constant P-R
- Infants: rate usually < 220 bpm
- Children: rate usually < 180 bpm

Search for and treat cause

Probable supraventricular tachycardia

- Compatible history (vague, nonspecific)
- P waves absent/abnormal
- HR not variable
- History of abrupt rate changes
- Infants: rate usually ≥ 220 bpm
- Children: rate usually ≥ 180 bpm

Consider vagal maneuvers (no delays)

- **If IV access readily available:**
  Give **adenosine** 0.1 mg/kg by rapid bolus
  Maximum first dose 6 mg
  May double first dose and give once
  Maximum second dose 12 mg

Or

- **Synchronized cardioversion:**
  0.5 to 1 J/kg; if not effective, increase to 2 J/kg Sedate if possible but don't delay cardioversion

- **Synchronized cardioversion:**
  0.5 to 1 J/kg; if not effective, increase to 2 J/kg
  sedate if possible but don't delay cardioversion
- May attempt **adenosine** if it does not delay electrical cardioversion

Expert consultation advised

- **Amiodarone** 5 mg/kg IV over 20-60 minutes

Or

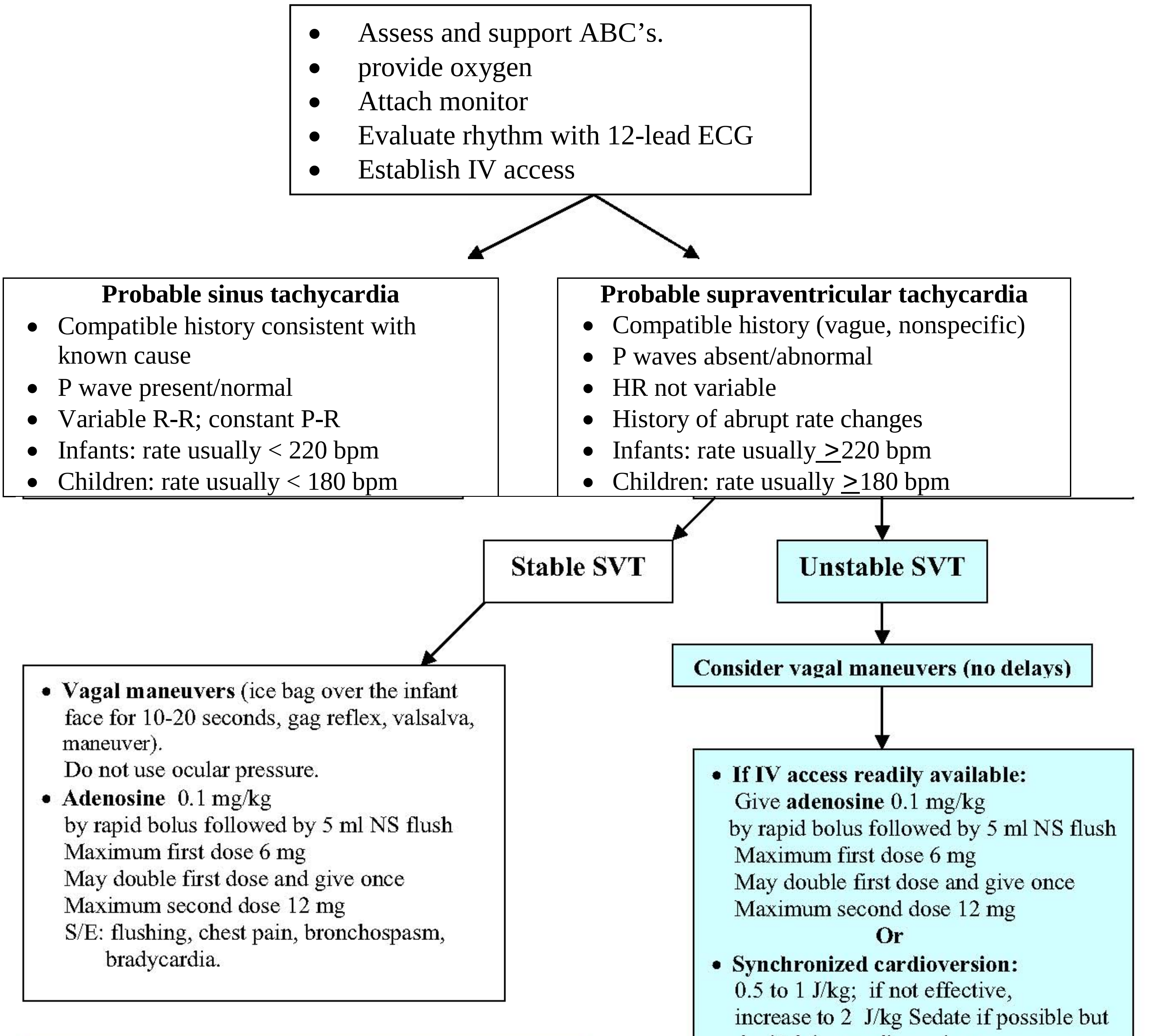
- **Procainamide** 15 mg/kg IV Over 30-60 minutes

Do not routinely administer amiodarone and procainamide together

Supraventricular Tachycardia (SVT)

Signs & Symptoms

Irritability, vomiting, poor feeding, chest pain, palpitation. Poor perfusion, tachycardia, signs of heart failure, shock



- Assess and support ABC's.
- provide oxygen
- Attach monitor
- Evaluate rhythm with 12-lead ECG
- Establish IV access

Probable sinus tachycardia

- Compatible history consistent with known cause
- P wave present/normal
- Variable R-R; constant P-R
- Infants: rate usually < 220 bpm
- Children: rate usually < 180 bpm

Probable supraventricular tachycardia

- Compatible history (vague, nonspecific)
- P waves absent/abnormal
- HR not variable
- History of abrupt rate changes
- Infants: rate usually ≥220 bpm
- Children: rate usually ≥180 bpm

Stable SVT

- **Vagal maneuvers** (ice bag over the infant face for 10-20 seconds, gag reflex, valsalva, maneuver).
  Do not use ocular pressure.
- **Adenosine** 0.1 mg/kg
  by rapid bolus followed by 5 ml NS flush
  Maximum first dose 6 mg
  May double first dose and give once
  Maximum second dose 12 mg
  S/E: flushing, chest pain, bronchospasm, bradycardia.

Unstable SVT

Consider vagal maneuvers (no delays)

- **If IV access readily available:**
  Give **adenosine** 0.1 mg/kg
  by rapid bolus followed by 5 ml NS flush
  Maximum first dose 6 mg
  May double first dose and give once
  Maximum second dose 12 mg

Or

- **Synchronized cardioversion:**
  0.5 to 1 J/kg; if not effective, increase to 2 J/kg Sedate if possible but don't delay cardioversion

Expert consultation advised

- **Amiodarone** 5 mg/kg IV over 20-60 minutes

Or

- **Procainamide** 15 mg/kg IV over 30-60 minutes
  Do not routinely administer amiodarone and procainamide together

Remarks

- Adenosine should be given through a **proximal** vein using 2 syringes connected to a T-connector or stopcock; give adenosine **rapidly** with one syringe and **flush** with ≥ 5 ml of NS
- Do not use verapamil in infants, it may cause refractory hypotension and cardiac arrest
- Assume wide QRS (> 0.08 sec) to be of ventricular origin and thus act accordingly

Management of heart failure due to acute myocarditis

Maintain ABCs
Admit to ICU
CVP monitoring

Inotropic support

- **Dobutamine:** 5 µg/kg/min (the first drug used initially)

If the patient is **hypotensive** add:

- **Dopamine:** 5 µg/kg/min (not used as first line inotropes unless the baby is hypotensive, (it causes tachycardia and subsequently reduced tissue perfusion)

- **Phosphodiesterase inihibitors**
  Milrinone
  - produces inotropic, vasodilator effect and after load reduction.
  - best used as infusion in combination with Dobutamine.
  - 50 µg/kg/dose IV over 15 min followed by continuous infusion 0.5-1 µg/kg/min
- **Diuretics:** Furosemide 1 – 2 mg/kg IV q12h (monitor electrolytes for hypokalemia).

- **Sedation:** Needed in the initial stages in the form of morphine or fentanyl if the baby is ventilated to reduce exhaustion.
- **Anticoagulation:** Used when LVEF is below 20% for the fear of developing mural thrombi in left ventricle. Heparin is used initially.
- Other Drugs can be used according to the cause of heart failure like Immnosuppressive agents, gamma Globulins etc.

After stabilization of the patient (may take few days)**:**

- Improvement of tissue perfusion
- Disappearance of Gallop Rhythm
- Clearance of lung signs

- Reduce IV inotropes gradually
- Start **digoxin** (maintenance): 0.01 mg/kg/day PO q12h
- Start **captopril**: (vasodilator/reduction of afterload)
  Infant/children: 0.1 mg/kg/dose PO q8hr
  titrate (if needed) to maximum 6 mg/kg/day (according to BP)
  Adolescents/adults: 12 – 25 mg/dose PO TID
  Increase weekly if necessary by 25 mg/dose to maximum 450 mg/day

Contraindicated in left ventricular outflow obstruction, e.g. critical aortic stenosis.

- Change IV furosemide to oral at the same dose and add
  Spironolactone: 2 mg/kg/day q12h
- If LVEF is still below 30% give baby aspirin 5 mg/kg/day. Sometimes it is important to continue oral anticoagulants as warfarin.

Management of heart failure due to shunt lesions (VSD, PDA, AVSD)

Furosemide: 1 – 2 mg/kg IV/PO q12h
and add
Spironolactone: 2 mg/kg/day q12h

↓

Captopril: (vasodilator/reduction of afterload)
Infants/children: 0.1 mg/kg/dose PO q8hr
titrate (if needed) to maximum 6 mg/kg/day according to BP
Adolescents/adults: 12 – 25 mg/dose PO TID
increase (if needed) by 25 mg/dose to maximum 450 mg/day
Contraindicated in left ventricular outflow obstruction, e.g. critical aortic stenosis.

- **Digoxin** can be started in some cases of heart failure in infants
  maintenance dose: 0.01 mg/kg/day q12hr (No digitalization needed)
- When starting digoxin with diuretics (frusemide and spironalactone), the dose given as 0.01 mg/kg/day q12hr
- If captopril is given with digoxin and diuretics, then spironolactone should be reduced or stopped according to potassium level.
- Digoxin toxicity can occur if the above 4 drugs are given and lower doses of digoxin should be given (0.0075 mg/kg/day q12hr)
- It is advisable that antifailure therapy be started by cardiologist initially in conditions of large left to right shunt lesions and in obstructive lesions

Management of chronic heart failure (with dilated cardiomyopathy and left ventricular dysfunction)

- Stable patients should be maintained on ACE inhibitors (e.g. Captopril, enalapril, Zestril) on long term. The doses are adjusted according to BP
- Diuretics are given in some patients as adjunctive therapy when left ventricular ejection fraction is < 40%
- Long acting Beta blockers have proven efficacy in patient with chronic heart failure. The drug used nowadays is Carvidalol 0.1 mg/kg/dose q12hr. increase slowly and monthly by 0.1 mg/kg/dose to maximum dose of 6.25 mg q12h

References:

1 Treatment of heart failure in children. Current Paediatrics. 2005. 15, 539-548
2 Pediatric Cardiology. Robort Anderson. Second edition, 2002.
3 Pediatric Cardiac Intensive Care. Anthony Chang 1999
4 The Harriet Lane Handbook 2002

Management of Heart Failure

Common causes of heart failure:

1.Congenital heart disease
    a.Large left to right shunt (VSD, AVSD, PDA)
    b.Obstructive lesions (coarctation, A.S)
    c.Anomalous left coronary artery from the pulmonary artery (ALCAPA)
2.Acute myocarditis.
3.Dilated cardiomyopathy (Familial, metabolic)
4.Restrictive cardiomyopathy

Physical Examination:

- Tachycardia
- Tachypnea with respiratory distress
- Arrhythmia particularly ventricular ectopy
- Weak peripheral pulses and or delayed capillary refill
- Heart sounds are often muffled with or without gallop rhythm
- Murmurs of the original disease
- Jugular venous distension may be observed in older children
- Pulmonary & systemic venous congestion are manifest by rales and hepatomegaly.

Investigations

- ECG: - low amplitude-sometimes abnormal axis-atrial or ventricular enlargement according to the original disease.
- Chest X-Ray: Cardiomegaly with pulmonary venous congestion.
- 2 Dechocardiogram: To check for cardiac anomalies and ventricular function.
- Complete blood count with differential.
- Blood culture and ESR if fever & infection are suspected.
- Creatinine Kinase (CK – MB)
- Viral IgM antibody titres (in suspected viral myocarditis)
- Serum carnitine, Lactase, pyruvate in suspected metabolic or familial cardiomyopathy

General Management

- Maintain ABCs, give oxygen and connect to a cardiac monitor
- If in shock intubate and ventilate
- Secure an IV line
- Keep fluid input/output chart
- Fluid restriction 70% ml/kg/day
- If the baby is tachypnoic consider feeding via NG tube
- Monitor serum electrolytes frequently (specially Potassium)
- Consult a cardiologist

DIGOXIN

Manifestations:

- Anorexia, nausea, vomiting occur early followed by headache, disorientation,somnolence. Cardiac findings include bradycardia with AV block and prolonged P-Rinterval. Any form of cardiac arrhythmia can occur.
- Massive over dose lead to severe hyperkalemia, VF, ventricular tachycardia, coma andseizure.
- Toxicity increases with hypokalemia, hypercalcemia, and hypomagnesemia.

Investigations:

- Collect serum digoxin & electrolyte level.
- Obtain an ECG, determine P – R interval.

Management:

- Basic measures including activated charcoal (even several hoursafter ingestion).
- Continuous ECG monitoring.
- Treat clinically significant arrhythmia:

* Bradycardia due to AV or SA block give atropine
0.01 mg/kg IV (Max. 0.5 mg.)

☐ * Ventricular arrhythmia give phenytoin (2mg/kg IV slowly over 20 min). Repeat every 5 min. till arrhythmia stopped or max. of 15-20 mg/kg. Lidocaine can also be used, 1mg IV bolus then 20-50 µgm/kg/min. continuous infusion.

☐ * Treat hyperkalemia aggressively. If serum potassium is more than 5.5 mEq/L use IV sod. Bicarb (1 mEq/kg), IV glucose (0.5 g/kg) & insulin (0.1 U/kg) infusion, and oral Kayxalate (sodium polystyrene sulfonate, 0.3 – 0.6 gm/kg) or Calcium resonium (oral or enema, 0.5 – 1 gm/kg).

Do not use calcium as it may worsen ventricular arrhythmia.

-Use Fab antibodies (digoxin antibodies or Digibind) in case of uncontrolled arrhythmia orsevere hyperkalemia unresponsive to treatment.(one vial = 40 mg, each can bind 0.6 mg digoxin).

$$\text{Dose: body load} = \frac{\text{serum level in ng/mL x 5.6 x wt. (kg.)}}{1000}$$

$$\text{Nuber of vials to be given} = \frac{\text{body load}}{0.5} \quad \text{(IV over 30 min.)}$$

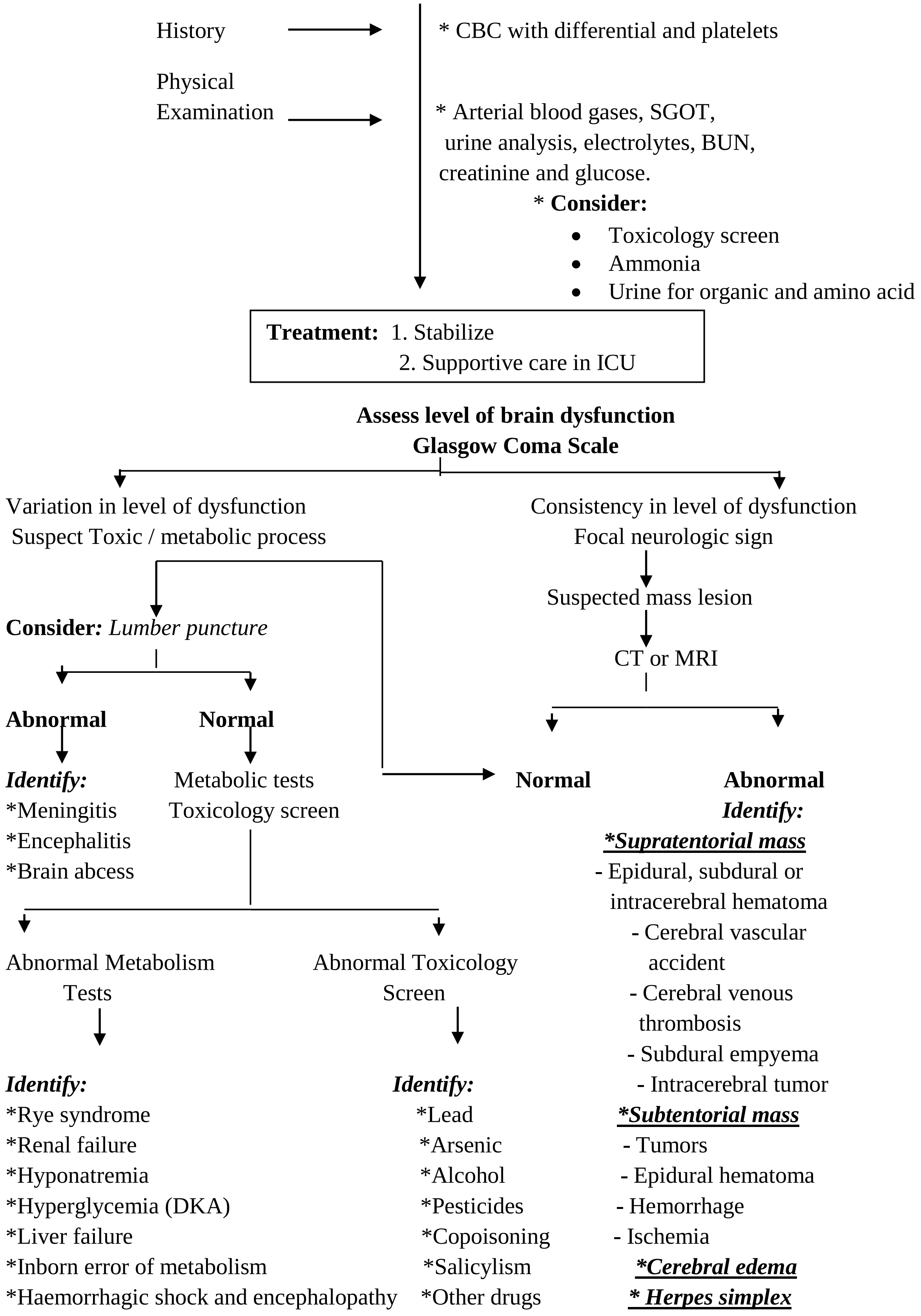
NB. 1. Give as bolus if cardiac arrest is imminent.

2. $\frac{\text{nmol/L}}{1.281}$ = ng/mL digoxin level.

REFERENCES:

1 Poisoning and drug overdose, 2004 Kent R. Olson.
2 Nelson Text Book of Pediatric. 2004. Richard E. Berman.

Patient with coma



History → Physical Examination →

* CBC with differential and platelets

* Arterial blood gases, SGOT, urine analysis, electrolytes, BUN, creatinine and glucose.

* **Consider:**
- Toxicology screen
- Ammonia
- Urine for organic and amino acid

Treatment: 1. Stabilize
2. Supportive care in ICU

Assess level of brain dysfunction
Glasgow Coma Scale

Variation in level of dysfunction
Suspect Toxic / metabolic process

Consider: *Lumber puncture*

Abnormal

Identify:
*Meningitis
*Encephalitis
*Brain abcess

Normal

Metabolic tests
Toxicology screen

Abnormal Metabolism Tests

Identify:
*Rye syndrome
*Renal failure
*Hyponatremia
*Hyperglycemia (DKA)
*Liver failure
*Inborn error of metabolism
*Haemorrhagic shock and encephalopathy

Abnormal Toxicology Screen

Identify:
*Lead
*Arsenic
*Alcohol
*Pesticides
*Copoisoning
*Salicylism
*Other drugs

Consistency in level of dysfunction
Focal neurologic sign

Suspected mass lesion

CT or MRI

Normal

Abnormal

Identify:

****Supratentorial mass***
- Epidural, subdural or intracerebral hematoma
- Cerebral vascular accident
- Cerebral venous thrombosis
- Subdural empyema
- Intracerebral tumor

****Subtentorial mass***
- Tumors
- Epidural hematoma
- Hemorrhage
- Ischemia

****Cerebral edema***

**** Herpes simplex***

Children's Coma Scale

(Modified Glasgow Coma Scale,Paediatric Coma Scale)

- One of the components of the Glasgow coma scale is the best verbal response, which cannot be assessed in nonverbal small children. A modification of the original Glasgow coma scale was created for children too young to talk.
- **Parameters:**
  1. eyes opening
  2. best verbal or nonverbal response (depending on development status)
  3. best motor response
- Additional markers associated with prognosis:
  1. Oculovestibular reflex (all children with absent reflexes died; 50% of children with impaired reflex died; 25% with normal reflexes died)
  2. Abnormal pupillary response (77% with bilateral fixed and dilated pupils died)
  3. Intracranial pressure (pressures > 40 torr with CCS scores of 3, 4 or 5 was inevitably fatal)
- Children's coma scale =(score for eye opening)+(score for best nonverbal or verbal response)+(score for best motor response)
- **Interpretation:**

1. minimum score is 3, which has the worst prognosis
2. maximum score is 15, which has the best prognosis
3. Scores of 7 or above have a good chance for recovery.
4. Scores of 3-5 are potentially fatal, especially if accompanied by fixed pupils or absent oculovestibular responses or elevated intracranial pressure.

Eye Opening	Score	Best Motor Response	Score
Spontaneously	4	obeys commands	6
To verbal stimuli	3	localizes pain	5
To pain	2	flexion withdrawal	4
Never	1	abnormal flexion (decorticate rigidity)	3
		extension (decerebrate rigidity)	2
		no response	1

Nonverbal Child	Verbal Child's Best Verbal Response (Glasgow coma scale)	Score
smiles, oriented to sound, follows objects, interacts	oriented and converses	5
Consolable when crying and interacts inappropriately	disoriented and converses	4
Inconsistently consolable and moans; makes vocal sounds	inappropriate words	3
inconsolable, irritable and restless; cries	incomprehensible sounds	2
no response	no response	1

Shock

- Shock results from inadequate blood flow and oxygen delivery to meet tissue metabolic demands.

Clinical picture:

A. Compensated shock

- Tachycardia
- Cool extremities
- Prolonged capillary refill (despite warm ambient temperature)
- Weak peripheral pulses compared with central pulses
- Normal blood pressure

B. Decompensated shock (inadequate end-organ perfusion)

- Signs of compensated shock and:

- Depressed mental status
- Decreased urine output
- Metabolic acidosis
- Tachypnea
- Weak central pulses and undetectable peripheral pulses
- Hypotension: a systolic blood pressure < 5th percentile of normal for age:
  - <60 mm Hg in term neonates.
  - <70 mm Hg in infants
  - <70 mm Hg + (2 x age in yrs) in children 1 to 10 years
  - <90 mm Hg in children >10 years of age.

C. Irreversible shock

Types of shock:

1 **Hypovolemic**: results from intravascular volume loss, hemorrhage and interstitial loss. (e.g.Gastroenteritis, burns, GI bleeding, sepsis and intestinal obstruction)

2 **Distributive:** due to vasodilation, resulting in a relative hypovolemia. (e.g. Anaphylaxis, spinal shock and Sepsis).

3 **Cardiogeni**c: due to impairment of cardiac contractility (e.g. Congestive heart failure, cardiomyopathy, sepsis).

4 Septic: Sepsis can lead to systemic vasodilation, intravascular fluid leak into tissue third spaces and depress myocardial function. Mainly caused by Gram-negative bacteria (endotoxic shock).

5 **Obstructive**: (e.g. coarctation of the aorta and severe valvular stenosis).

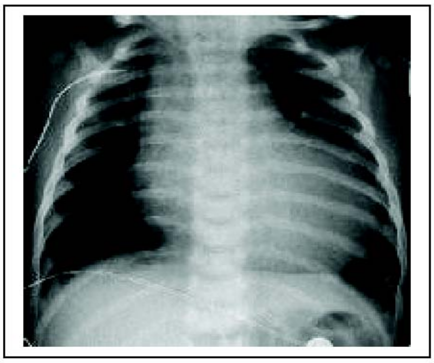


Fig. 1 Chest X-R with cardiomegaly

Investigations:

- CBC, electrolytes, HCO3, renal and liver function test, blood culture, ABG.
- Chest X-R: May help delineate cardiogenic from hypovolemic shock (Fig.1)

Management:

- Ensure the ABCs and administer 100% supplemental oxygen
- Secure 2 large-bore IV lines. If vascular access is not available insert IO
- Intravenous fluids: Administer 20 mL/kg of 0.9% NS over 10-15 minutes. If no improvement may repeat the cycle. If no response to fluids, colloid can be used (5% albumin, or blood products).
- In severe hypovolemia or sepsis more than 60 mL/kg of volume may be required in the first hour of resuscitation. Consider central venous pressure (CVP).
- If CVP < 10 mmHg, continue fluid therapy CVP > 10 mmHg with poor perfusion, give vasoactive agents (see table).
- Place urinary catheter and maintain urine output 1-2 ml/kg/h. Can use furosemide 1 mg/kg/dose IV after restoring intravascular volume.
- If hypoglycemia; give IV dextrose 0.5-1 g/kg.
- If the patient has refractory central hypotension or a cardiogenic shock Inotropic agents must be employed (see table).
- Acidosis usually is corrected with volume supplementation and optimal ventilation. In persistent shock or severe acidosis (PH< 7.15 or HCO3 < 10 mEq/l) give NaHCO3 1 mEq/kg IV over 10-15 min (before correcting acidosis correct hypocalcemia and assure adequate ventilation)
- Initial coverage with empiric antibiotics is essential in critical patients.
- Corticosteroid is debated. It is lifesaving in adrenal cortical insufficiency.

Medication	**Dose**	**Comment**
Dobutamine	2-20 µg/kg/min IV/IO‡	Inotrope; vasodilator
Dopamine	2-20 µg/kg/min IV/IO‡	Inotrope; chronotrope; renal and splanchnic vasodilator in low doses; pressor in high dose
Epinephrine	0.1-1 µg/kg/min IV/IO*	Inotrope; chronotrope, vasodilator in low doses; pressor in higher doses
Norepinephrine	0.1-2 µg/kg/min*	Inotrope; vasopressor

‡ 6 x body weight (in kg) = mg of drug to add to 100 ml D5W then, an IV rate of 1 ml/h delivers 1 µg/kg/min of drug

* 0.6 x body weight (in kg) = mg of drug to add to 100 ml D5W then, an IV rate of 1 ml/h delivers 0.1 µg/kg/min of drug

References:

1 American Heart Association. Part 12: Pediatric Advanced Life Support. *Circulation*. 2005; 112: IV.
2 Barkin R, Rosen P. *Emergency Pediatrics A Guide to Ambulatory Care*: fifth edition 1999.
3 Adam Schwarz. Shock: October 2004. http//www.emedicine.com

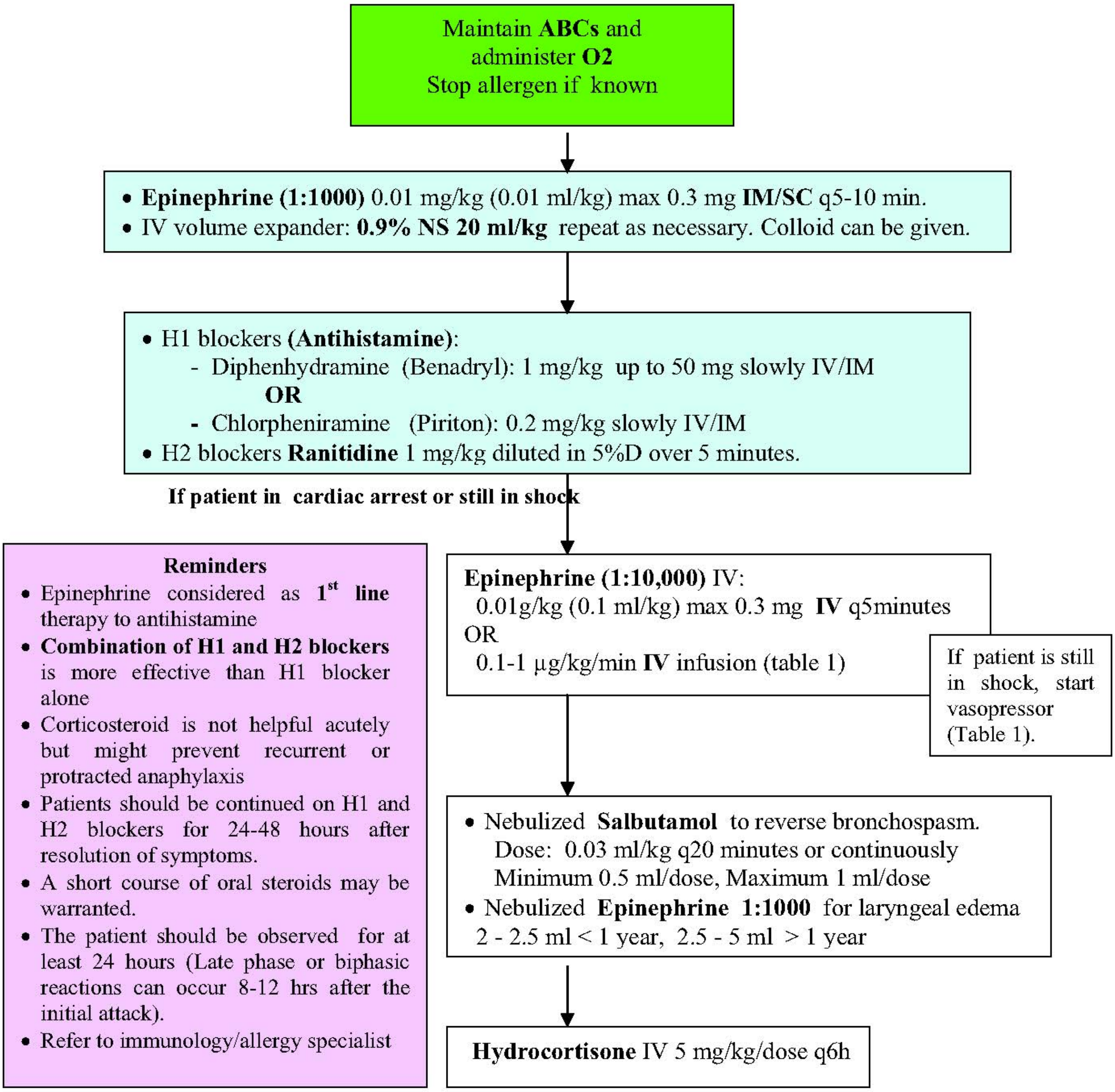
Anaphylaxis

Anaphylaxis is a rapidly evolving multi-system allergic reaction characterized by symptoms or signs of **respiratory** and/or **cardiovascular** involvement. Other systems may be involved such as the skin and/or the gastrointestinal tract.

Etiology: Common causes of anaphylaxis in children include allergies to foods, medications, insect stings and others.

Clinical features: Stridor, cough, chest tightness, wheezing, difficulty in swallowing, tachycardia, shock, syncope, arrhythmia, flushing, urticaria, angioedema, vomiting, abdominal cramps, diarrhea, unconsciousness.

Management:



Maintain **ABCs** and
administer **O2**
Stop allergen if known

- **Epinephrine (1:1000)** 0.01 mg/kg (0.01 ml/kg) max 0.3 mg **IM/SC** q5-10 min.
- IV volume expander: **0.9% NS 20 ml/kg** repeat as necessary. Colloid can be given.

- H1 blockers **(Antihistamine)**:
  - Diphenhydramine (Benadryl): 1 mg/kg up to 50 mg slowly IV/IM
    OR
  - Chlorpheniramine (Piriton): 0.2 mg/kg slowly IV/IM
- H2 blockers **Ranitidine** 1 mg/kg diluted in 5%D over 5 minutes.

If patient in cardiac arrest or still in shock

Epinephrine (1:10,000) IV:
0.01g/kg (0.1 ml/kg) max 0.3 mg **IV** q5minutes
OR
0.1-1 μg/kg/min **IV** infusion (table 1)

If patient is still in shock, start vasopressor (Table 1).

- Nebulized **Salbutamol** to reverse bronchospasm.
  Dose: 0.03 ml/kg q20 minutes or continuously
  Minimum 0.5 ml/dose, Maximum 1 ml/dose
- Nebulized **Epinephrine 1:1000** for laryngeal edema
  2 - 2.5 ml < 1 year, 2.5 - 5 ml > 1 year

Hydrocortisone IV 5 mg/kg/dose q6h

Reminders
- Epinephrine considered as 1st **line** therapy to antihistamine
- **Combination of H1 and H2 blockers** is more effective than H1 blocker alone
- Corticosteroid is not helpful acutely but might prevent recurrent or protracted anaphylaxis
- Patients should be continued on H1 and H2 blockers for 24-48 hours after resolution of symptoms.
- A short course of oral steroids may be warranted.
- The patient should be observed for at least 24 hours (Late phase or biphasic reactions can occur 8-12 hrs after the initial attack).
- Refer to immunology/allergy specialist

Table 1.

Medication	Dose	Comment
Dopamine	2-20 µg/kg/min IV/IO‡	Inotrope; chronotrope; renal and splanchnic vasodilator in low doses; pressor in high dose
Epinephrine	0.1-1 µg/kg/min IV/IO*	Inotrope; chronotrope, vasodilator in low doses; pressor in higher doses
Norepinephrine	0.1-2 µg/kg/min*	Inotrope; vasopressor

‡ 6 x body weight (in kg) = mg of drug to add to 100 ml D5W then, an IV rate of 1 ml/h delivers 1 µg/kg/min of drug

* 0.6 x body weight (in kg) = mg of drug to add to 100 ml D5W then, an IV rate of 1 ml/h delivers 0.1 µg/kg/min of drug

References:

1 The diagnosis and management of anaphylaxis, An updated practice parameter. *J Allergy Clin Immunol* .2005; 115:S483-523. Established by the American Academy of Allergy, Asthma and immunology (AAAAI) and the American College of Asthma and Immunology (ACAAI).
2 Understanding Anaphylaxis: Defining, Identifying and Treating Severe Allergic Reactions. *Infectious Disease In Childhood.* April 2004.
3 Pediatrics, Anaphylaxis. Jeffrey F Linzer. February 2006 *www. emedicine.*
4 ASCIA 2004. ASCIA is the peak professional body of clinical immunologists and allergy specialists in Australia and New Zealand.

Approach to a child with hypertension

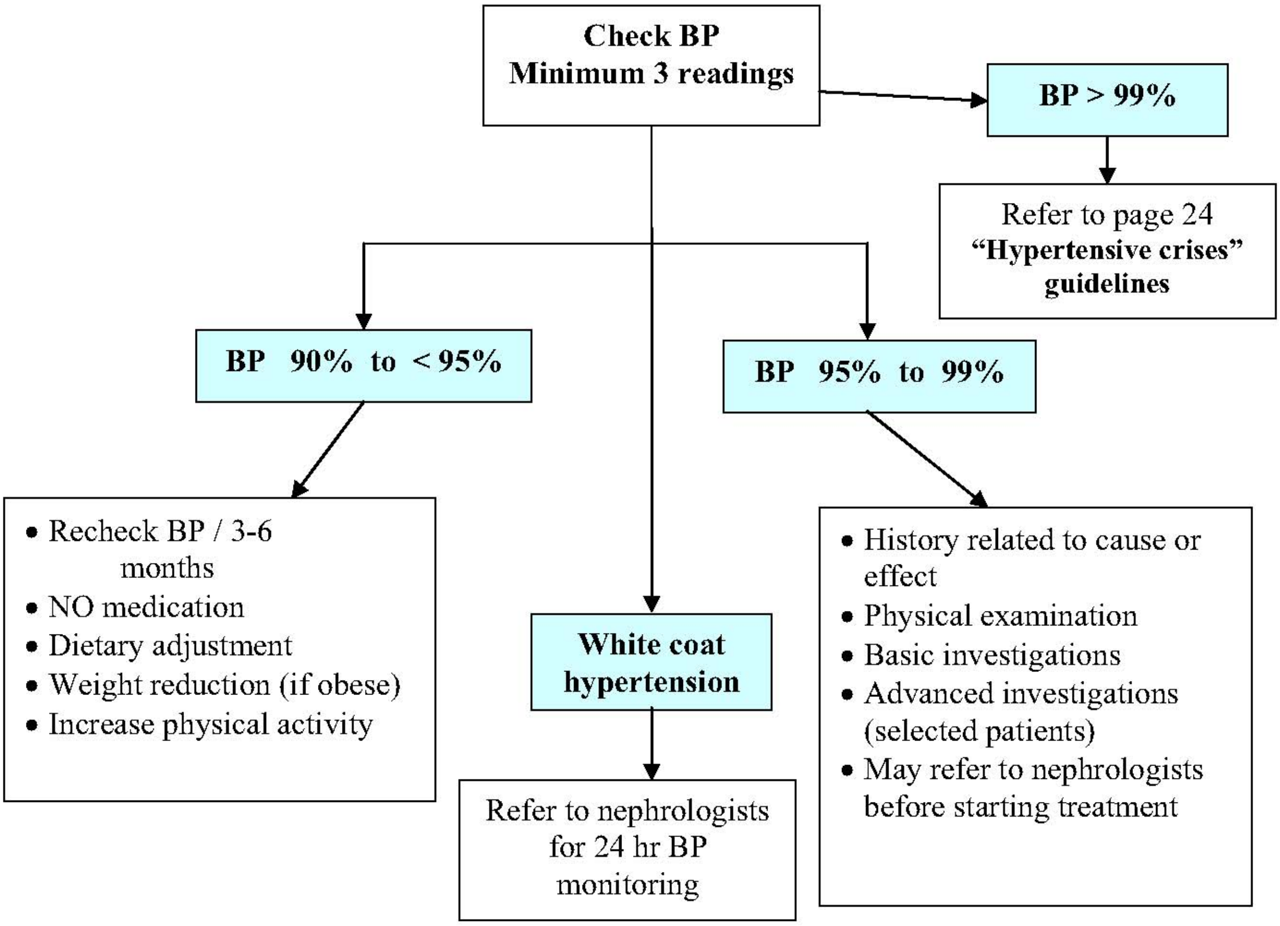
Definitions:

- **Prehypertension**: Systolic and/or diastolic BP levels 90th but < 95th percentile
- **White-coat hypertension:** BP > 95th percentile in a physician's office or clinic, who is normotensive outside a clinical setting
- **Hypertension**: Systolic and/or diastolic BP ≥ 95% percentile on ≥3 occasions
- Severe hypertension: BP > 99% for age, sex, and height percentile

- **Hypertensive emergency:** Severe HTN with evidence of end organ damage
- **Hypertensive urgency:** Severe HTN without evidence of end organ damage

Approach:

- Ensure BP is truly elevated (exclude errors like cuff size, instrument,) follow guidelines for proper BP measurement (refer to page 104)
- Exclude reactive increase in BP (e.g. pain, emotions, time of the day)
- How high blood pressure is ? (refer to BP norms page 107) Follow the algorithm:


Check BP
Minimum 3 readings
BP > 99%
Refer to page 24 "Hypertensive crises" guidelines
BP 90% to < 95%
BP 95% to 99%
Recheck BP / 3-6 months
NO medication
Dietary adjustment
Weight reduction (if obese)
Increase physical activity
White coat hypertension
Refer to nephrologists for 24 hr BP monitoring
History related to cause or effect
Physical examination
Basic investigations
Advanced investigations (selected patients)
May refer to nephrologists before starting treatment

History should include:

Pre-existing hypertension and renal diseases, presence of cardiac and neurological symptoms, and medication history.

Physical Examination should include:

- Assessment of the patient's volume status (volume overload needs diuretics, volume depletion stimulates rennin-angiotensin system)
- Assessment of end organ involvement
  -Fundus exam: Look for papilledema and hard exudates
  -Cardiac exam: cardiomegaly, S3, S4, murmur
  -Neurologic exam: for any deficit

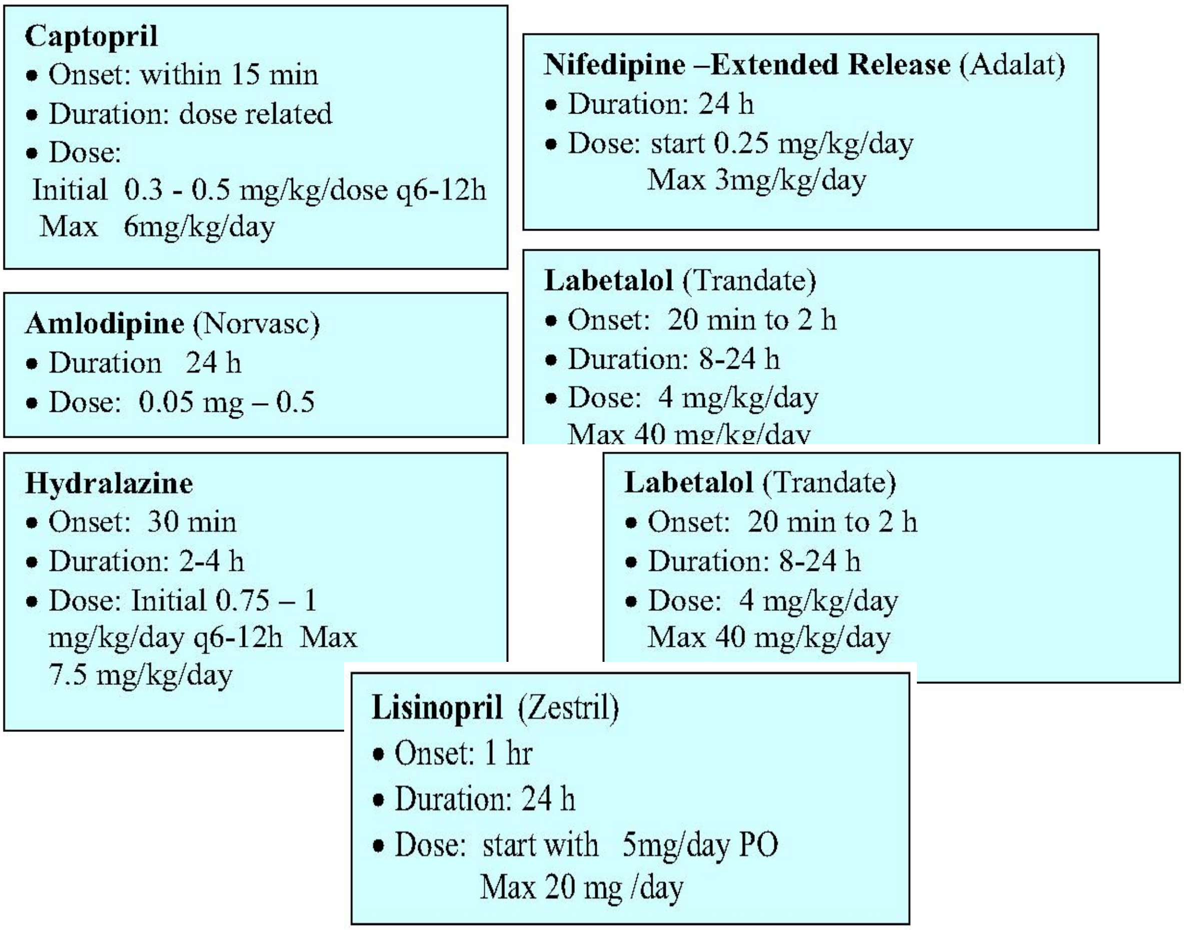
Basic investigations should be done to all patients with HTN

- CBC
- BUN,
- Creatinine, electrolytes,
- Calcium
- Urine analysis and culture
- Renal U/S
- ECG
- DMSA before and after ACE inhibitors
- Lipid profile
- Fundoscopy by ophthalmologist

Advanced investigations done for selected patients (as indicated)

- Plasma renin and aldosterone
- Urine catecholamines
- Thyroid function test,
- FSH (for polycystic ovary)
- Renovascular imaging studies (U/S with Doppler, contrast tomography angiography CTA, magnetic resonance angiography MRA, arterial angiography)

Commonly used (per oral) antihypertensive drugs:



Captopril
- Onset: within 15 min
- Duration: dose related
- Dose:

Initial 0.3 - 0.5 mg/kg/dose q6-12h
Max 6mg/kg/day

Amlodipine (Norvasc)
- Duration 24 h
- Dose: 0.05 mg – 0.5

Hydralazine
- Onset: 30 min
- Duration: 2-4 h
- Dose: Initial 0.75 – 1 mg/kg/day q6-12h Max 7.5 mg/kg/day

Nifedipine –Extended Release (Adalat)
- Duration: 24 h
- Dose: start 0.25 mg/kg/day
  Max 3mg/kg/day

Labetalol (Trandate)
- Onset: 20 min to 2 h
- Duration: 8-24 h
- Dose: 4 mg/kg/day
  Max 40 mg/kg/day

Labetalol (Trandate)
- Onset: 20 min to 2 h
- Duration: 8-24 h
- Dose: 4 mg/kg/day
  Max 40 mg/kg/day

Lisinopril (Zestril)
- Onset: 1 hr
- Duration: 24 h
- Dose: start with 5mg/day PO
  Max 20 mg /day

☐
☐
☐
☐ **May refer to nephrologists:**
☐

- When suspecting white coat hypertension
- When hypertensive crises is suspected
- BP is confirmed to be persistently high (> 95%) after the required investigation

Hypertensive Crises

Definitions:

Severe hypertension: BP > 99% for age, sex, and height percentile

- Hypertensive emergency
  Severe HTN with evidence of end organ damage
- Hypertensive urgency
  Severe hypertension without evidence of end organ damage

*NB. Refer to BP norms in index (page 107-110)

Pictures of target (end) organ damage

- CNS: Encephalopathy, seizures, facial palsy, hemiplegia
- Visual: Blurred vision , diplopia, findings of retinopathy
- CVS: LVH, CHF, chest pain
- Renal: polyuria / polydipsia, acute renal failure
- GI: abdomial pain, GI bleeding
- Hematologic: microangiopathic hemolytic anemia

Management:

- Distinguish between hypertensive emergency and hypertensive urgency
- Take a quick history including pre-existing hypertension and renal diseases, presence of cardiac and neurological symptoms, and medication history.
- Physical Examination

☐ o Proper BP measurement

☐ o Assess the patient's volume status (volume overload needs diuretics, volume depletion stimulates rennin-angiotensin system)

☐ o Assess end organ involvement

☐ - Fundus exam: Look for papilledema and hard exudate

☐ - Cardiac exam: cardiomegaly, S3, S4, murmur

☐ - Neurologic exam: for any deficit

Investigations:

- The Investigations at this stage is mainly to assess target organ damage
  :-CBC with blood film (looking for schistocyte suggesting hemolysis)
  -Electrolyte,
  BUN, and creatinine (look for renal impairment)
  -Chest X-ray (cardiomegaly and/or pulmonary edema)
  -ECG
  -Urine analysis (look for proteinuria, hematuria, or cast), urine c/s
- Whenever possible obtain renal U/S, cardiac Echo, head CT scan if signs of encephalopathy present

Hypertensive emergency

- Take a quick history and Physical examination
- Admit to ICU
- Monitor BP (Preferably arterial line)
- Place the patient on cardiac monitor
- Draw blood for CBC, electrolytes, RFT
- CXR & ECG
- Start **IV medication**:

- **The goal** for BP reduction is to achieve**, controlled** reduction in BP to minimize the risk of hypoperfusion in cerebral, coronary, and renovascular beds
- **Controlled reduction = Rate of reduction**

  1/3 of total amount to be reduced over 6 hrs
  Further 1/3 over 24 -36 hrs
  Final 1/3 over 48-72 hr

Faster reduction rate (within minutes) would be recommended in cases of pulmonary edema and dissecting aorta

There are no absolute recommendations regarding which agent to use.

- Use the one you are familiar with and most comfortable using.
- Use agent with short half-life.
- Treatment with constant infusion gives steadier, more controlled, and dependable response.

Labetolol

- Onset of action: 2-5 min
- Duration: 2-4 hr
- **Starting dose:** 0.4 – 1 mg/kg/hr, followed by
- **continuous infusion:** 0.25 – 3.0 mg/kg/hour

  OR

  -**bolus**: 0.2–1.0 mg/kg/dose (Max: 20 mg/dose) repeat q10 min if necessary
- Contraindicated in asthma, uncompensated CHF, pulmonary edema
- Recommended for HTN with high ICP

Sodium Nitroprusside

- Onset of action: seconds to 2 min
- Duration: 1-10 min
- **Starting dose:** 0.3 – 0.5 µg/kg/min (titrate dose to get the desired effect)
- **Usual Maintenance dose**: 3 - 4 µg/kg/min
- **Maximum dose :** 10 µg/kg/min
- Contraindicated in coarctation of aorta, AV shunt
- Monitor Thiocyanate level if > 72 h use, high dose > 4mcg/kg/min, or renal failure
- Monitor cyanide level in pt with hepatic dysfunction

Hydralazine

- Onset: (of IV) 5-20 min
- Duration: (of IV) 2-6 hrs
- Bolus doses only
- **starting dose:** 0.1-0.2 mg/kg/dose IV (Max 20 mg/dose) Q 4 -6hr
- **Maximum dose:** 1.7 – 3.5 mg/kg/day

Hypertensive urgency

- Admit to the general ward
- Take history & physical examination
- IV access NOT needed
- Blood for : CBC, electrolyte, RFT
- Urine analysis
- CXR
- ECG
- Start **Oral** medication:

The goal is to reduce BP over longer period (days not hours)

Captopril

- **Initial dose:** 0.3-0.5 mg/kg/dose q6-12
- **Maximum:** 6 mg/kg/day

If a maximum dose reached and the blood pressure still high **add** a calcium channel blocker:

Amlodepine (Norvasc)

- **Starting Dose: (child)** 0.1 mg/kg/dose PO QD-BID
- may increase to maximum 0.6 mg/kg/day up to 20 mg/day

If BP still high **add**:

Hydralazine

- **Starting dose:** 0.75-1 mg/kg/day q6-12hours Increase over 3-4 weeks to a **maximum dose:** 7.5mg/kg/day

Other oral antihypertensive drugs

Propranolol : 1-2 mg/kg/day q6-12h maximum 8 mg/kg/day
(best for pheochromocytoma)
Nifedipine (can be used if Amlodepine not available):
Initial dose: 0.25-0.5 mg/kg/day qd-bid PO
Maximum: 3 mg/kg/day up to 180 mg/day

(**Sublingual** is **not** recommended)

Status Epilepticus

Definition:
An episode of continuous seizure or, intermittent seizures (without recovery of consciousness) lasting for > 30 minutes. May be convulsive or non-convulsive, partial or generalized.

Etiology:

- Majority of patients with status epilepticus are not known to be epileptics.
- 30-50% are complications of an acute CNS insult (CNS infection, glucose or electrolytes disturbance) especially in young children.

Management:

A. Resuscitation and stabilization

- Check ABCs and continue monitoring
- Clear airway and suction, insert an airway
- keep on lateral prone position to prevent aspiration.
- ± NG tube insertion to decompress and empty stomach.
- 100% O2 by face mask .
- IV/IO access and collect blood (CBC , BGA , glucose, electrolytes including Ca, Mg, phosphorus, liver and renal profile , septic workup , anticonvulsant level, ± toxicology screen).
- If hypoglycemic give 2 ml/kg of 10% dextrose
- If hypotensive with poor peripheral perfusion treat as in shock
- If patient is shocked or cyanosed with dilated pupils at any stage of management or has been convulsing an hour or more , go straight to stage IV.

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B. Anticonvulsants

Stage I

- **Lorazepam**:0.05 – 0.1 mg/kg IV (maximum 4mg)
- OR **Diazepam**: 0.3 mg/kg IV (maximum 10mg) undiluted over 2 minutes.
- If IV access could not be established give
  Diazepam rectal 0.5 mg/kg OR
  Midazolam IM 0.2mg/kg.

If seizure does not stop within 5 – 10 minutes
Go to stage II

- If seizure stops adjust previous anti-epileptic medications
- or ± start oral anticonvulsants (the decision depends on the likelihood for seizure recurrence).

Stage II

- **Lorazepam**:0.05 – 0.1 mg/kg IV (maximum 4mg)
- OR **Diazepam**: 0.3 mg/kg IV (maximum 10mg) undiluted over 2 minutes.
- **Phenytoin**: 15-20mg/kg (maximum dose 1000mg) IV infusion
  Rate 1mg/kg under ECG monitor
  Proper infusion as 10 mg phenytoin/ml
- Or **Fasphenytoin**: 20 mg/kg IV infusion (rate 3mg/kg/min)
- Consider **pyridoxine** (100mg IV) for child <2years of age.
- Start 20% **Mannitol** 5ml/kg over 20 minutes.
- If still convulsing 10 minutes after starting phenytoin may give 3rd dose of **Diazepam**

If there is response, continue **phenytoin** 5mg/kg/day q 12h follow blood level

If no response 5min after
The end of Phenytoin Infusion

Stage III

Phenobarbitone loading dose 15-20 mg/kg IV, slowly over 10 minutes Be repeated for ventilation and intubation.

- If no response in 5-10 minutes after the end of infusion
- Or seizure already >60 minutes
- Or unstable vital signs

If there is response, continue maintenance **phenobarb** 5mg/kg/day q 12h follow

Stage IV (ICU Care)

- **Intubation + Ventilation ± muscle relaxant (**use short acting muscle relaxant in repeated doses**) to monitor seizure when EEG monitoring is not available**

Midazolam: 0.2mg/kg IV bolus Then infusion 0.05mg/kg/h up to 0.5 mg/kg/h

- During infusion maintain phenytoin and phenobarbitone at high therapeutic level
- If seizure is not controlled in 1-2 hours induce barbiturate coma

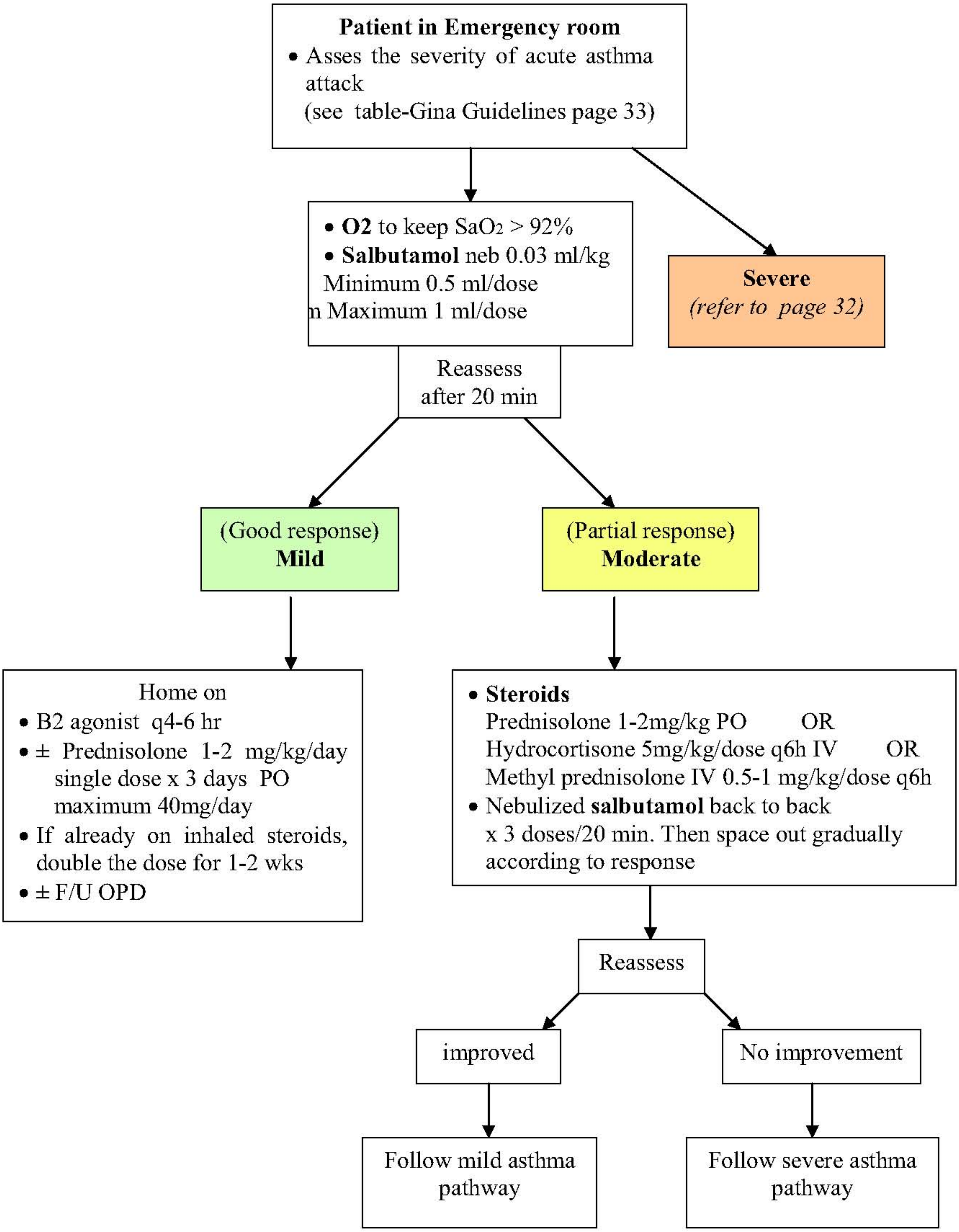
OR

Barbiturate coma

- **Thiopentone** 50 mg/kg/h till seizure stops then reduce infusion to 5 mg/kg/h (increase up to 20 mg/kg/h when needed, titrating for best control)
- **OR**
- **Phenobarb** 10 mg/kg every ½h till control (up to 120mg/kg/day)

- Monitor for BP, Hypoglycemia, electrolyte imbalance, hypocalcemia, acidosis, consumptive coagulopathy (PT< APTT) and hyperpyrexia.
- Restrict fluid to 60% maintenance (unless low BP) and continue treatment for brain edema with **Mannitol** q 6h ± **Dexamethasone** (with IV **Cimetidine**)
- After stabilization consider CT scan and work up for possible causes.
- Treat for CNS infection if indicated (L.P. after brain CT scan)

Guidelines in the Management of Acute Bronchial Asthma



Patient in Emergency room
- Asses the severity of acute asthma attack
(see table-Gina Guidelines page 33)

- **O2** to keep $SaO_2 > 92\%$
- **Salbutamol** neb 0.03 ml/kg
Minimum 0.5 ml/dose
n Maximum 1 ml/dose

Severe
(refer to page 32)

Reassess
after 20 min

(Good response)
Mild

(Partial response)
Moderate

Home on
- B2 agonist q4-6 hr
- ± Prednisolone 1-2 mg/kg/day single dose x 3 days PO maximum 40mg/day
- If already on inhaled steroids, double the dose for 1-2 wks
- ± F/U OPD

- **Steroids**
Prednisolone 1-2mg/kg PO OR
Hydrocortisone 5mg/kg/dose q6h IV OR
Methyl prednisolone IV 0.5-1 mg/kg/dose q6h
- Nebulized **salbutamol** back to back x 3 doses/20 min. Then space out gradually according to response

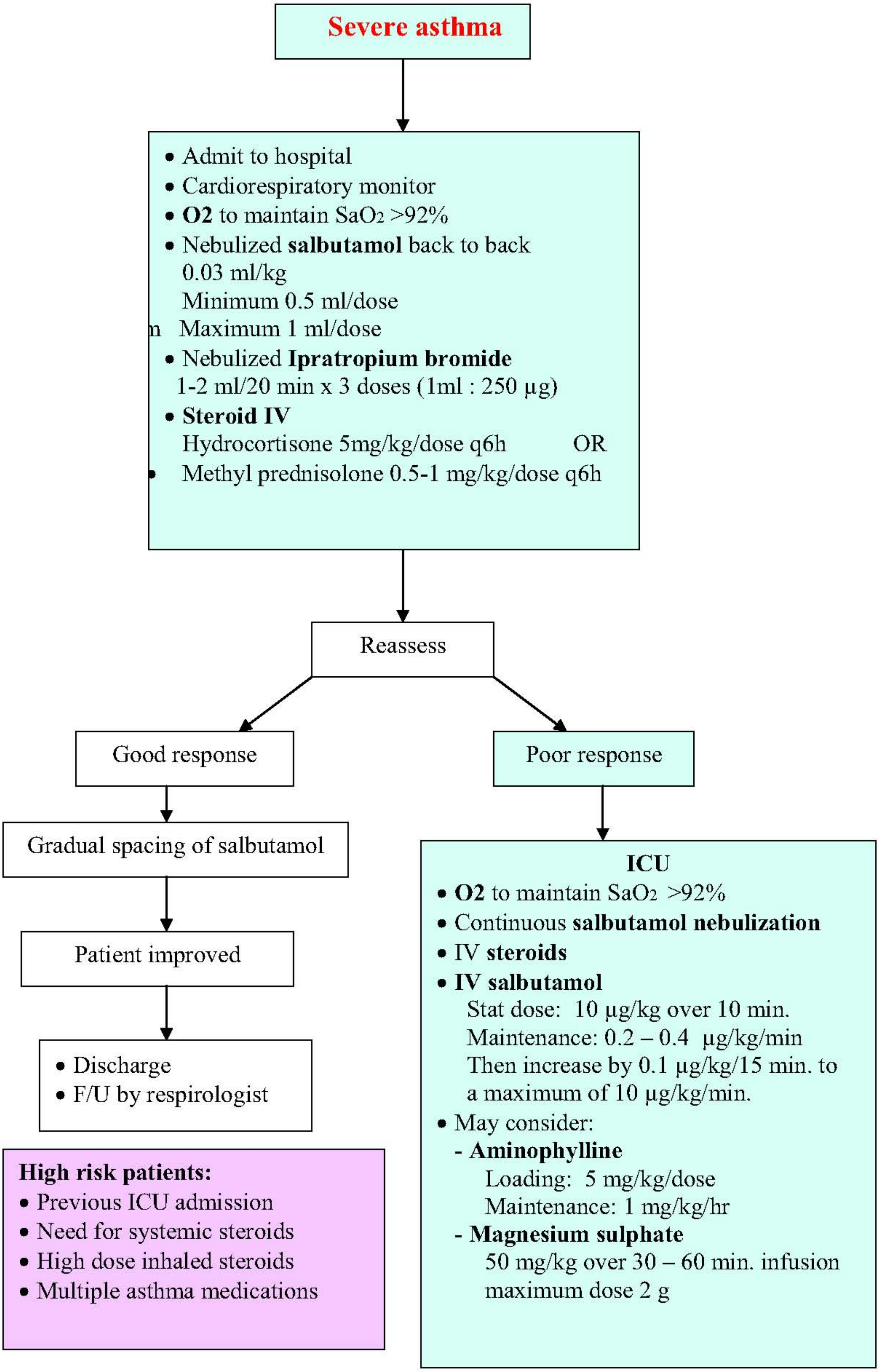
Reassess

improved

No improvement

Follow mild asthma pathway

Follow severe asthma pathway



Severe asthma

- Admit to hospital
- Cardiorespiratory monitor
- **O2** to maintain SaO_2 >92%
- Nebulized **salbutamol** back to back
  0.03 ml/kg
  Minimum 0.5 ml/dose
  Maximum 1 ml/dose
- Nebulized **Ipratropium bromide**
  1-2 ml/20 min x 3 doses (1ml : 250 µg)
- **Steroid IV**
  Hydrocortisone 5mg/kg/dose q6h OR
  Methyl prednisolone 0.5-1 mg/kg/dose q6h

Reassess

Good response

Gradual spacing of salbutamol

Patient improved

- Discharge
- F/U by respirologist

Poor response

ICU

- **O2** to maintain SaO_2 >92%
- Continuous **salbutamol nebulization**
- IV **steroids**
- **IV salbutamol**
  Stat dose: 10 µg/kg over 10 min.
  Maintenance: 0.2 – 0.4 µg/kg/min
  Then increase by 0.1 µg/kg/15 min. to a maximum of 10 µg/kg/min.
- May consider:
  - **Aminophylline**
    Loading: 5 mg/kg/dose
    Maintenance: 1 mg/kg/hr
  - **Magnesium sulphate**
    50 mg/kg over 30 – 60 min. infusion
    maximum dose 2 g

High risk patients:

- Previous ICU admission
- Need for systemic steroids
- High dose inhaled steroids
- Multiple asthma medications

Severity of Asthma Attacks

Parameter	Mild	Moderate	Severe	Respiratort arrest imminent
Breathless	Walking Can lie down			
Talks in	Sentences	Phrases	Words	
Alertness	May be agitated	Usually agitated	Usually agitated	Drowsy or Confused
Respiratory rate	Increased	Increased	Often > 30/min	Paradoxical
Accessory muscles and suprasternal retractions	Usually not	Usually	Usually	Paradoxical thoraco abdominal movement
Wheeze	Moderate, often only end expiratory	Loud	Usually loud	Absence of wheeze
Pulse/min	< 100	100-120	> 120	Bradycardia
PaO2 (on air) And/or	Normal test Not usually necessary	> 8	< 8 possible cyanosis	
PaCO2	< 6 Kpa	< 6	> 6 possible respiratory failure	
SaO2 % (on air)	> 95%	91-95%	< 90%	
PEF After initial bronchodilator % predicted or % personal best	> 80%	Approximately 60-80%	< 60%	

Guide to rates of breathing associated with respiratory distress in a wake child

Age	Normal rate
< 2 months	< 60/min
2-12 months	< 50/min
1-5 years	< 40/min
6-8 years	< 30/min

Foreign body aspiration

- Can be a life threatening event. Aspirated object can lodge in the larynx or trachea.
- If the object is large enough, it can cause complete obstruction and death.
- Symptoms depend on the site, duration, size and type of foreign body.
- Commonest age 1-3 years but can occur at any age

Signs of upper airway obstruction: Respiratory distress, coughing, stridor, hoarseness of voice, wheezing, and cyanosis
Signs of lower airway obstruction: Cough, recurrent infections, asthma like symptoms not responding to treatment, hemoptysis and bronchiectasis

Approach:

Suspected foreign body in the upper airway

- patient should be assessed and stabilized in the resuscitation roon in the presence of experienced personal in airway management
- If the child has respiratory distress and is unable to speak or cry, complete airway obstruction is likely present, and the likelihood of morbidity or mortality is high. In those cases, a Heimlich maneuver may be used. If the child is able to speak, the Heimlich maneuver would be contraindicated, as it might dislodge the material to an area where it could cause complete airway obstruction.
- Patient should be referred to a specialized center for rigid bronchoscopy (chest hospital) NB. If the patient is stable enough, CXR PA and lateral should be done

Suspected foreign body in the lower airway

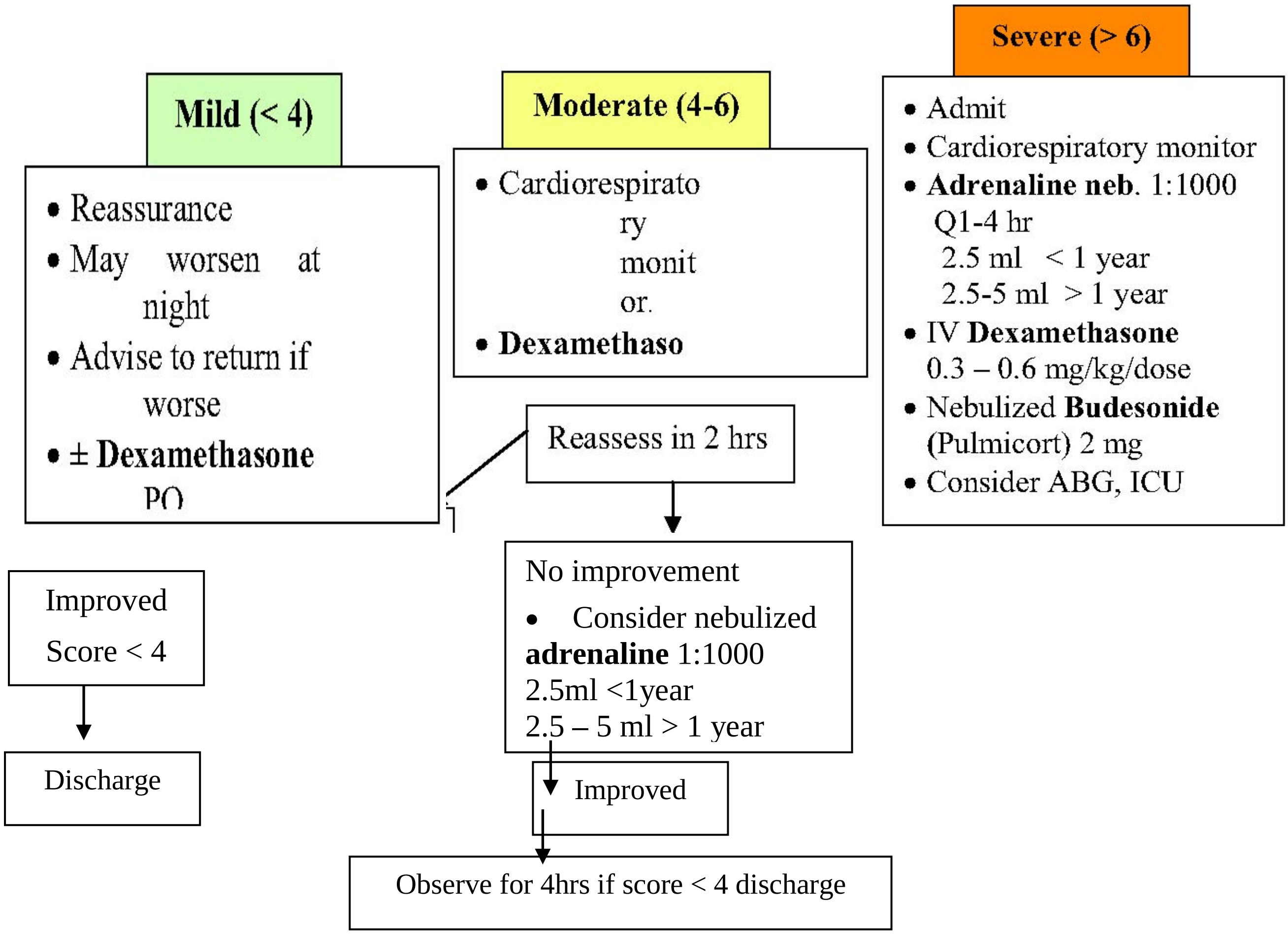
  - Absence of history and/or normal CXR cannot exclude foreign body aspiration.
  - Check ABCs and stabilize the patient.
  - keep NPO and no chest physiotherapy.
  - May try bronchodilators.
  - If organic foreign body is suspected, start (hydrocortisone IV 5 mg/kg/dose) prior to bronchoscopy.
- CXR inspiratory/expiratory films in cooperative patients or right & left lateral decubitus films.
- CXR findings: - normal lung fields (fig.1) -unilateral hyperinflation (fig. 2) -atelectasis -foreign body (radio-opaque) -if severe and chronic might show bronchiectatic changes.
- Patient should be referred to a specialized center for rigid bronchoscopy (chest hospital)

Laryngeo-tracheo-bronchitis (LTB) – Croup

- Consider other causes of upper airway obstruction (e.g. foreign body aspiration, epiglotitis, tracheitis).
- X-rays in the acute phase are rarely justified and may compromise the airway, with the exception of a positive history of foreign body aspiration or in the face of poor response to treatment.
- Keep the child upright and comfortable. Minimise upsetting examinations or procedures.
- **Severity scoring** - Westley Modified Croup Score

Clinical feature	Degree	Score
Stridor	None At rest on auscultation At rest without auscultation	0 1 2
Recession	None Mild Moderate Severe	0 1 2 3
Air entry	Normal Decreased Severely decreased	0 1 2
Cyanosis	None With agitation At rest	0 4 5
Consciousness level	Normal Altered	0 5

Possible score 0-17 Mild < 4 , Moderate 4-6, Severe >6


Mild (< 4)
• Reassurance
• May worsen at night
• Advise to return if worse
• ± Dexamethasone PO
Improved
Score < 4
Discharge
Moderate (4-6)
• Cardiorespiratory monitor.
• Dexamethaso
Reassess in 2 hrs
No improvement
• Consider nebulized adrenaline 1:1000
2.5ml <1year
2.5 – 5 ml > 1 year
Improved
Observe for 4hrs if score < 4 discharge
Severe (> 6)
• Admit
• Cardiorespiratory monitor
• Adrenaline neb. 1:1000 Q1-4 hr
2.5 ml < 1 year
2.5-5 ml > 1 year
• IV Dexamethasone 0.3 – 0.6 mg/kg/dose
• Nebulized Budesonide (Pulmicort) 2 mg
• Consider ABG, ICU

Rehydration in gastroenteritis

Make sure you are familiar with the commonly used rehydration solutions:

	Content	Osmolality
Normal saline	Na = 150 mmol/L Cl = 150 mmol/L	300 mOsmol/kg
0.45 NS 5% D	Na = 75 mmol/L Cl = 75 mmol/L Glucose = 50 g/L	428 mOsmol/kg
0.225 NS	Na = 37 mmol/L Cl = 37 mmol/L	
4 % KCL 15 % KCL	K = 0.5 mmol/ml K = 2 mmol/ml	
8.4 % NaHCO3	HCO3 = 1 mmol/ml Na = 1 mmol/ml	
Human plasma	Na = 145 mmol/L K = 4.5 mmol/L	290 mOsmol/kg
WHO-ORS	Na = 90 mmol/L K = 20 mmol/L Citrate = 30 mmol/L Glucose = 110 mmol/L	320 mOsmol/kg

NB:

1 Carbonated drinks and apple juice should NOT be used for rehydration (they contain no sodium and have 10-12% sugar concentration).
2 The type of rehydrating solution is chosen according to its Sodium content.

Principles:

1 Correction of hypovolemia or shock.
2 Replacement of deficit.
3 Provision of maintenance.
4 Allowance for ongoing losses (if any).
5 Attention to the sodium status.

1. Hypovolemia or shock

- 20 ml/kg NS over 30 – 60 minutes (for adolescents start with 10 ml/kg) can be repeated if no response.

2. Deficit Replacement

1) Volume (depends on degree of dehydration)

	Younger children	Older children
Mild	50 ml/kg	30 ml/kg
Moderate	75 ml/kg	50 – 60 ml/kg
Severe	100 ml/kg	70 – 90 ml/kg

2) Sodium content (depend on sodium losses)

Status	Approximate Na loss
Isonatraemia (acute)	100 mmol/L
Isonatraemia (chronic)	70 – 80 mmol/L
Hyponatremia	120 mmol/L
Hypernatraemia	40 –60 mmol/L

Apart from hypernatremia:

The sodium content of a rehydrating solution for deficit replacement is 80 – 100 mmol/L

3. Maintenance Requirements

a) Volume:

For water or calories

Weight	Water (or calorie) requirement
Birth – 10 kg	100/kg
11 – 20 kg	1000 + 50 /kg above 10
21 – 30 kg	1500 + 20 /kg above 20

b) Sodium: 2-4 mmol/kg/day

c) Potassium: 2-3 mmol/kg/day

4. Ongoing losses

Practical :

- If IV hydration is considered, you can successfully rehydrate most children with these solutions:
- - Normal Saline (150 mmol Na/L)
- - 0.45 NS in D5% (75 mmol Na/L)and add 4 % KCL (0.5 mmol/ml)
- You start with 20 ml NS in any child with more than moderate dehydration, discount them from the deficit.
- You can then give: Portion 1: ½ deficit + 1/3 maintenance ………6 – 8 hours Portion 2: ½ deficit + 2/3 maintenance ………16 hours
- Notice that: Na content in deficit fluid: 80 – 120 mmol/L Na content in maintenance fluid: 30 mmol/L They are mixed in portion 1 and portion 2 Hence one solution is satisfactory
- 0.45 NS = 75 mmol/L
- Potassium:

- To each litre: add 20 – 30 mmol K = 40 – 60 ml 4% KCl
- OR To each 500 ml: add 10 – 15 mmol K = 20 – 30 ml 4% KCl

maximum potassium concentration

- **in peripheral IV = 40 mmol/L (20 mmol/pint = 40 ml 4% KCl)**
- **in central IV = up to 80 mmol/L (40 mmol/pint = 80 ml 4% KCl)**

Example :

A 12 months old child with GE is admitted with severe dehydration. His weight was 10 kg. Total fluid needed:

Deficit = 10 x 100 = 1000 ml

Maintenance = 10 x 100 = 1000 ml Step 1: IV 0.9%NS 200 ml over 60 minutes Step 2: IV 0.45 NS in 5% D 500 ml + 4% KCl 25 ml

-Volume: 700 ml -Duration: 7 hrs This provided: ½ the remaining deficit (400) + 1/3 of the maintenance (300) = 700 ml Step 3: IV 0.45 NS in 5% D 500 ml + 4% KCl 25 ml

-Rate: 60 ml/h -Duration: 16 hrs -Volume: 1000 ml (approx.) This provided ½ the remaining deficit + 2/3 of the maintenance

Hyponatraemic dehydration

Serum Sodium < 130 mmol/L

1. Asymptomatic hyponatraemia

In the previous example

Step 1: IV 0.9%NS 200 ml over 60 minutes (same as in isonatraemia)

Step 2: IV 0.45 NS in 5% D 500 ml + 25 ml 4%KCl (Rate/duration as in isonatremia)

Step 3: IV 0.45 NS in 5% D 500 ml + 4% KCl 25 ml (Rate/duration as in isonatremia)

2 **Symptomatic hyponatraemia**

-Critical care

-Consider 3% saline 5 ml/kg over 10 – 15 minutes -Call your senior for possible repeat

-Then proceed as in hyponatraemia

This situation is exceedingly rare in GE; consider other diagnosis e.g. congenital adrenal hyperplasia, severe brain insult, etc.

Hypernatraemic dehydration

Serum Sodium $\geq$ 150 mmol/L

In the previous example:

1 **Step 1** (shock): 200 ml 0.9%NS IV over 1 hour

2 **Step 2**: Remaining deficit 800 ml + Maintenance of 2 days (1000 ml x 2) = 2800 ml

Give uniformly **over 48 hrs**

Solution: 0.45 NS in 5 %D 500 ml + 25 ml KCl for each bottle

3 **Avoid**: Rapid infusion and hypotonic solutions.

General guidelines

1 better under hydrate than over hydrate

2 care for the kidney and she will care for minor miscalculations. This is by providing 20 ml NS/kg in case of hypovolemia

3 the total fluid volume should rarely exceed 200 ml/kg/day in infants, and be lower than 175 in toddlers.

4 an acute stormy onset, especially with prominent vomiting is a reason for concern -is it really GE? -Shock is early -Sodium losses are severe

5 an overweight infant is misleading -signs of dehydration are late and can be missed -they may be already in shock when recognized -hypernatraemia is a risk

6 an underweight infant -has poor tolerance to the usual calculations -needs calories more than water and sodium -signs of dehydration are exaggerated

7 a drowsy child with GE is critical -associated CNS infection -Brain oedema (hyponatraemia) -Brain dehydration (hypernatraemia)

8 abdominal distension with GE is always abnormal (expected to have scaphoid abdomen) -perforated appendix -intussusception -septicaemia, late NEC -hypokalaemia

9 revisits are mandatory specially during the first few hours

10 is it really GE ? is always a wise question to ask yourself, before a surgeon does!

- Do not exceed 100 ml/kg for deficit replacement
- Loss usually occurs over days and rehydration over hours. This process is not physiological

Management of electrolytes disturbances

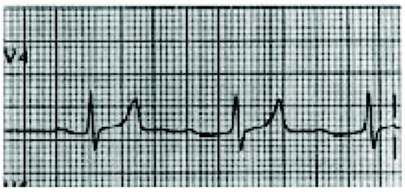
1. Hyperkalemia

Definition: serum potassium > 5.5 mmol/L (child).
> 6.5 mmol/L (infant)

Etiology:

Acidosis, hemolysis, Renal failure, Tumor lysis syndrome, Addison disease, Obstructive uropathy, Adrenogenital syndrome, Hypoaldosteronism, spironolactone, Digitalis intoxication, Rhabdomyolysis, hemolyzed sample. ECG changes:

Tall T wave. Long PR interval, wide QRS, Absent P wave, sinusoidal wave.



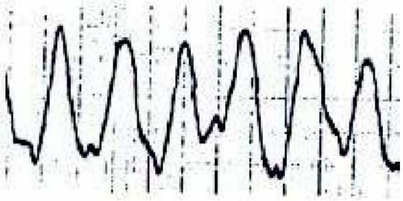


Fig.1 Tall T waveFig.2 Sinusoidal wave

Management:

- Ensure sample not hemolyzed.
- Stop all exogenous potassium (IV ,oral ,drugs ,blood product transfusion)
- Cardiac monitor.
- **Serum K > 7 mEq/L OR any hyperkalemia with ECG changes**

1. Calcium (cardioprotective) with ECG monitoring
   Calcium gluconate 10% 0.5-1 ml/kg/dose IV over 5-10 min.
   OR
   Calcium chloride 10% 0.2 ml/kg/dose IV over 5-10 min.
   - Can be repeated up to 4 times or until serum calcium increases or
   - ECG normalizes.
   -Its effect lasts about 30 minutes.
2. NaHCO3 1-2 mmol/kg/dose IV over 30 min. q 2-4 hr. Do not mix with calcium in same IV line (results in precipitation)
3. Glucose 1 g/kg IV +/– insulin 0.1 unit/kg IV over 30 min. May repeat in 30-60 min.
4. Ca resonium 1 g/kg/dose q 4-6 hr PO/PR
5. Salbutamol nebulization.
6. Consider dialysis if above measures unsuccessful.

2. Hypokalemia

Definition: serum potassium less than 3.5 mmol/LEtiology: vomiting, diarrhea, metabolic alkalosis, Barter syndrome, mineralocorticoid excess,prolonged use of corticosteroid, loop diuretics, laxatives, beta2 adrenergic agent, insulin,distal renal tubular acidosis, recovery phase of DKA, polyuric acute renal failure.Clinical features: weaknesss, hyporeflexia, paresthesia, polyuria, polydypsia, ileus.ECG changes: prolonged QT interval, ST segment depression, flat T wave, U wave,dysrrhythmia.

Management:

- Oral potassium 2-4 mmol/kg/d in divided doses (for mild asymptomatic
- ▪ hypokalemia)

OR

- Potassium IV (infusion) not to exceed 0.3-0.4 mmol/kg/h
- Maximum IV (infusion) rate = 0.5 mmol/kg/h can be given under ECG monitoring.
- *maximum potassium concentration
- in peripheral IV = 40 mmol/L (20 mmol/pint)
- in central IV = up to 80 mmol/L (40 mmol/pint)

3. Hyponatremia

Definition: Serum sodium concentration of less than 130 mmol/L

Etiology:
1 low sodium intake (infants fed with hypotonic formula)
2 Excessive loss of sodium (Renal loss: renal failure, adrenal insufficiency, diuretics) (Extrarenal losses: G.I. loss, skin loss, third space)
3 Excessive water retention (SIADH, nephrotic syndrome, congestive heart failure)
4 Pseudohyponatremia.

Clinical picture: Symptoms usually appear when serum sodium < 125 mmol/L. Muscle cramps, weakness, headache, anorexia, emesis, seizures, coma and death.

Management: Sodium deficit = Weight in kg x 0.6 x (desired Na – actual Na)

- **Symptomatic hyponatremia (seizures)**
  - ○ 3% sodium chloride IV at a rate of 5 ml/kg over 10-20 min. Following resolution of symptoms, correction can proceed at a slower rate (deficit over 16 hours to raise serum sodium to **125mmol/L**). OR
  - ○ Correct serum sodium to **125 mmol/L** over 0.5-4 hr. Then raise serum sodium to 135 meq/L over subsequent 24h.

- **Asymptomatic hyponatremia (no seizures)**

☐ o In hypovolemic hyponatremia, correct 50% of deficit over first 8 hr and remainder over next 16 hr. Use 0.9% or 0.45% saline for replacement and maintenance therapy.
☐ o In normovolemic hyponatremia, restrict fluids (two-thirds maintenance).
☐ o In hypervolemic hyponatremia, restrict fluids (two-thirds maintenance). Can use diuretics (furosemide 1-2mg/kg q6-12hr).

Rapid correction in compensated chronic hyponatremia results in central pontine myelinosis. However, rapid correction in acute hyponatremia is well tolerated. 1 mL of 3% sodium chloride = 0.5 mmol Na/L.1 mL/kg of 3% sodium chloride raises the serum sodium by 1.6 mmol/L.

4. Hypernatremia

Definition: serum sodium > 150 mmol/L

Etiology:
1 Decreased total body water (diarrhea, diabetes insipidus, increased insensible water loss).
2 Excess total body sodium (salt poisoning, primary hyperaldosteronism, cushing's syndrome).

Clinical presentation: Lethargy alternating with irritability, high pitched cry, tremors, ataxia, seizures, altered mental status, hypertonia, fever, doughy skin.

Management:

- Rapid correction can cause cerebral edema.
- Restore circulating volume and urinary output as priority.
- Give fluid deficit and maintenance of 2 days over 48 hours.
- Fluid to be used should be 0.45% NS. With altered mental status or seizures, higher sodium concentration may be needed.
- If sodium fall is too rapid; increase the sodium concentration in the fluid. Recommended rate of correction is 0.5 mmol/L/h.
- If the serum sodium concentration is more than 200 mmol/L, peritoneal dialysis should be done using a high glucose, low sodium dialysate.

5. Hypocalcemia

Definition:

- Serum calcium < 2 mmol/L

Clinical presentation:

Lethargy, poor feeding, vomiting, abdominal distension, twitching, tetany, seizures, apnea, stridor, laryngospasm.

ECG changes:

Prolonged Q-Tc interval. (normal < 0.45 sec)

Management:

- **Asymptomatic hypocalcemia**

  100 mg/kg/d elemental calcium PO divided q6-8h.
- **Symptomatic hypocalcemia** (seizures, laryngospasm, cardiac dysrhythmia, muscle spasm/cramps)
  - 10% Calcium gluconate 0.5-1.0 ml/kg/IV (diluted) over 5-10 min

  followed by:
  - 10% Calcium gluconate 1-2 ml/kg/dose q4-6hr bolus infusion diluted to 2% (mix 10 ml of 10% calcium gluconate in 40 ml NS to obtain 2% solution)

    OR
  - continuous IV infusion 5 – 8 ml/kg/day of 10% calcium gluconate diluted to 2%
- All patients on IV calcium should be on cardiac monitor.
- Integrity of the intravenous site should be ascertained before administering calcium through a peripheral vein.
- Adjust infusion rate q4h based on plasma Ca level. Reduce infusion rate slowly once desired level reached then start oral calcium.
- Monitor IV site for extravasation burns and venous thrombosis.
- o Correct hypomagnesemia (Mg < 0.6 mmol/l) because hypocalcemia does not respond until magnesium level is corrected.-Magnesium sulfate 50% 0.2 ml/kg/dose IM/IV slowly.
- Consider starting vitamin D

Alfacalcidol (One-Alpha drops): 0.05 µg/kg/day (one drop provides 0.1 µg)

Management of Diabetic Ketoacidosis in Children

Diagnostic criteria

- Plasma glucose>14mmol/L or 400-800mg\dl.
- Urinary ketones > ++ and hyperketonemia.
- Venous bicarbonate < 18 and/or arterial pH < 7.30 =Metabolic acidosis.

Diagnostic Studies in DKA

- Chemistry
  - ↑ Glucose
  - ↓ Bicarbonate
  - **Anion gap = $(Na^+) – (Cl^- + HCO_3^-)$**
  - Frequently seen:
    - ↑ BUN/creatinine (dehydration)
    - ↑ potassium
    - ↓ sodium
- **Pseudohyponatremia**: to correct, **add 1.6 mEq of sodium to every 100mg/dL of glucose above the first one.**
- **Serum acetones**
  - **Positive in DKA;**
- **Urinalysis**
  - **Ketones (for DKA); WBC (for UTI)**
- **CBC**
  - **Leukocytosis (possible infection) -st one**

DKA treatment protocol

TIME	THERAPY	COMMTNTS
1st hour	10-20 ml/kg IV bolus 0.9 % NaCl or LR insulin drip 0.05 to 0.1 ų/kg/hr	Quick volume expansion; may be repeated, NP0 Monitor I/0 neurologic status, use flow sheet, have manitol at bed side
2nd hour until DKA resolution	0.45% NaCl plus continuo insulin drip 20 mEq/L KPhos and 20 mEq/L KAc 5% glucose if blood sugar < 250 mg/dL(14m mol/L)	IV rate = 85ml/kg+maintnance-bolus 23 hr If K<3 mEq/L give 0.5-1mEq/kg as oral K solution or increase iv K to 80 mEq/L
Variable	0ral intake with subcut. insulin	No emesis, co2 ≥ 16mEq/L, Normal electrolytes
Note that the initial Iv bolus is considerd part of the total fluid allowed in the first 24 hr and is subtracted before calculating the Iv rate. Maintenance (24 hr) =100 ml/kg for the 1st 1o kg, 50ml/kg for the 2nd ,25ml/kg for the 3rd Reversal of DKA is associated with inherent risks that include hypoglycemia, hypokalemia, and cerebral edema		

Emergency assessment: Confirm the diagnosis

- History of polyuria, polydepsia, weight loss, vomiting and abdominal pain.
- Biochemical confirmation
- Glycosuria.
- Ketonuria
- Blood Glucose (BG)
- Blood gas analysis (BGA)/ bicarbonate

Clinical assessment:

- Assessment of Conscious level
- Severity of Dehydration:
- 3% just detectable
- 5% dry mucous membranes
- 10% capillary return 3 seconds or more, sunken eyes.
- 10 % + shock, poor peripheral pulses
- Signs of Shock and poor perfusion.
- Evidence of Acidosis and hyperventilation.

Immediate investigation:

- Weigh the child.
- Capillary blood glucose (by finger prick)
- Venous blood glucose, bicarbonate, electrolyte and urea.
- Capillary, venous or arterial blood gases.
- Height measurement to calculate body surface area

Clinical observations and monitoring:

> **Careful frequent clinical and laboratory to detect warning signs of complications is of paramount importance.**

- Hourly pulse rate, respiratory rate, BP.
- Hourly or more frequent neurological observations including GCS.
- Flow sheets: metabolic, fluid intake and output, fluid type, dose and exact time of insulin administration.
- Hourly capillary BG (cross-check every 2 or 4 hours against venous glucose until acidosis is corrected.
- Venous bicarbonate & electrolytes every 2 hours after start of therapy then 4 hourly until acidosis reversed.
- Check for K+ hourly if abnormal (< 3 or >6) an ECG monitoring is recommended.

What to do in persistent acidosis?

Persistent acidosis is likely to be caused by inadequate resuscitation, inadequate insulin effect or sepsis.

In presence of ongoing acidosis (with normalization of blood glucose) the amount of glucose should be adjusted in the infusion to maintain BG between 8 – 12 mmol/L, by adding 7.5% or 10% dextrose and to continue insulin infusion at a rate of 0.1u/kg/h. Reduce insulin dose only after acidosis has been corrected.

7.5% D : add 25ml of 50 % D to 500ml 5% dextrose. 10D: add 50ml 0f 50% D to 500ml 5% dextrose.

Transition to SC insulin injections:

- Oral fluids should only be introduced when substantial clinical improvement has occured (mild acidosis: Bicarbonate > 15mmol/L / ketosis may still present.)
- When oral fluids are tolerated IV fluids should be reduced.
- Start the SC insulin at appropriate timing (before breakfast, lunch or dinner, never at midnight) for subsequent convenience:

  -0.4 – 0.6 u/kg/day of fast and intermediate acting insulin.
  -As starting dose, 2/3 of the dose before breakfast and 1/3 before dinner.
  -If before lunch, give 0.25u/kg SC of fast acting insulin.
  -These are just starting doses , it is to be adjusted based on the BG levels.

Cerebral edema:

Occurs in the first 24 hours after starting rehydration when the general condition of the childmight seem to be improving.Monitor at regular interval to detect any changes consistent with cerebral edema.

- **Risk Factors:**
  - ☐ o High serum urea nitrogen concentration at presentation.
  - ☐ o Hypocapnia (low CO2)
  - ☐ o Slow rise of serum Na
  - ☐ o Severe acidosis.

- Warning signs/symptoms:
  - ☐ o Headache & slowing of heart rate.
  - ☐ o Change in neurological status (restlessness, irritability, increased drowsiness, incontinence), specific neurological signs (e.g. cranial N palsies).
  - ☐ o Rising BP, decreased O2 saturations
  - ☐ o Convulsions, papiloedema, respiratory arrest are late signs.

- Management of cerebral edema:
  - ☐ o Exclude hypoglycemia
  - ☐ o If warning signs occur (see above) give immediate IV Mannitol 0.25 – 1g/kg over 20 minutes (i.e. 1.25 – 5ml /kg 20% solution).
  - ☐ o Halve rehydration infusion rate until situation is improved.
  - ☐ o Nurse with child's head elevated.
  - ☐ o Move to intensive care unit.
  - ☐ o Alert anesthetic and senior pediatric staff.
  - ☐ o Cranial imaging should only be considered after child has been stabilized. Intracranial events other than edema may occur e.g. hemorrhage, thrombosis and infarction.

Management of new cases who do not present with DKA (only hyperglycemia)

- Patient is to be admitted to the hospital (even if not in acidosis at first presentation).
- Same initial investigation.
- IV fluids to be administered according to the level of dehydration.
- **Insulin therapy:**

1 If patient is admitted to the ward in the morning can be given SC insulin. A combination of rapid acting and intermediate acting (½ and $^2/_3$). The starting dose is 0.5 – 0.7 units/day. $^2/_3$ in the morning.

2 If the patient is admitted around noon time (lunch time), can be given 0.25 u/kg as rapid acting before lunch.

3 If the patient is admitted in the evening, calculate the dose as 0.5 – 0.7 u/kg/day, and give $^{1}/_{3}$ of that as a combination of rapid and intermediate acting.

☐ 4. If the patient is admitted at any other time, i.e. middle of the night or mid morning, afternoon:

- Can give small dose of insulin SC 0.1U/kg or less in children < 2 years old.
- Monitoring of blood sugar regularly, every 2 hours.

Management of Children with Diabetes During Surgical Procedures:

General Anesthesia:

Elective surgery:

1 Operation to be scheduled for early morning to avoid prolonged fasting.

2 Admit to hospital the afternoon prior to surgery for morning and major operations or early morning for minor operations later in the day.

3 Evening prior to surgery:

☐ a. Usual evening insulin and regular dinner, and bed time snack.

☐ b. Ketosis or severe hyperglycemia will necessitate correction, by overnight IV insulin infusion and might cause a delay in surgery.

4. Morning Operations:

☐ a. Fast from midnight.

☐ b. Water allowed up to 4 hours preoperatively

☐ c. Omit usual morning insulin dose.

☐ d. Start IV fluid and insulin at 6.00 – 7.00 am (see table)

☐ e. Hourly blood glucose (BG) monitoring preoperatively; half-hourly during operation and until waken-up anesthesia.

☐ f. Hourly BG for 4 hours post operatively.

☐ g. Aim is to keep BG 5 – 12 mmol/L

☐ h. Continue IV infusion until the child tolerates oral fluids and snacks.

☐ i. Change to usual SC insulin before the first meal is taken.

☐ j. Stop insulin infusion 30 minutes after SC insulin is taken.

5. Afternoon Operations:

☐ a. Give 1/3 of the usual morning insulin dose as short acting insulin.

☐ b. Allow a light breakfast.

☐ c. Clear fluids up to 4 hours before the surgery.

☐ d. Start IV fluids and insulin infusions at mid-day (table 1).

☐ e. Then as morning operations.

Emergency Surgery:

1 May not be sufficient time to optimally evaluate and stabilize the patient.

2 Efforts should be made to delay surgery until DKA is treated, even if not complete resolution.

3 If cannot be postponed, treatment of DKA should be initiated and continue throughout the operative and preoperative period.

4 If no ketoacidosis, start IV fluid and insulin infusions as for elective surgery.

5 Potassium specially is checked frequently.

Local Anesthesia:

- Preferably in the morning to avoid prolonged fasting
- Insulin is to be decreased:-1/2 - 2/3 of the intermediate acting
- No short acting.
- BG is to be measured before surgery:
  - If > 15mmol/L, give small amount of short insulin (0.25U/kg)
  - If < 5mmol/L, IV glucose is to be given
  - Usual meal plan and insulin schedule is to be resumed postoperatively.

Short Surgical Procedures (< 1 hour) and During Investigations (CT, MRI……):

1- Give 2/3 of the daily dose of the insulin as intermediate acting SC.
2- Do not give any short acting insulin.
3- The patient must have a sugar containing IV fluid (D5%-0.45NS) with added potassium at the maintenance rate.
4- BG is to be checked every 2 hours before the procedure and amount of glucose is adjusted accordingly.
5- Post-operatively, BG should be checked immediately and every 4 hours.
6- Maintain BG between 5 – 12 mmol/L.
7- Oral intake is to be started according to patient's state of wakefulness, usually with clear fluids and then gradually to normal diet. Can be discharged once oral intake is tolerated on previous insulin regimen.

1. Maintenance fluid guide:

- Glucose 5% or 10% with 0.45 normal saline
- If infusion for > 12 hours add KCl 20mmol/L

Body weight	Fluids/12 hours
3-9 kg	100ml/kg

For each kg between 10-20 kg, Add 50 ml/kg For each kg over 20 kg, Add 20ml/kg (max 2000ml).

2. Insulin infusion:

Add 10 units of soluble (short acting) insulin to 100ml 0.9% NS making solution of 1 unit/10ml (1ml = 0.1 unit)

- Start infusion at rate 0.5ml/kg/hr
- Maintain BG between 5 – 12 mmol/L
- Do not stop insulin if BG < 5mmol/L reduce the rate and give IV glucose.
- If BG < 3, stop infusion for only 15 minutes.

Hypoglycemia in D. M.

Definition:

1 In theory, hypoglycemia is the level of blood glucose (BG) at which physiological neurological dysfunction begins.

2 In practice, neurological dysfunction can be symptomatic or asymptomatic, and the level at which it occurs varies between individuals, time and circumstances, usually less than 3.5mmol/l.

Causes: (a mismatch between insulin, food and exercise)

1 Excessive insulin administration.
2 Delayed or missed meals and/or snacks.
3 Inter-current illness with vomiting.
4 Unanticipated exercise.

Symptoms & Signs:

1 Autonomic activation : (BG 2.1 – 3.5mmol/L) hunger, trembling of hands or legs, palpitations, anxiety, pallor, sweating).

2 Neurological symptoms (impaired thinking, change of mood, irritability, dizziness, headache, tiredness, confusion and later convulsions and coma).

Neuroglycopenia may occur before autonomic activation (causing hypoglycemia unawareness).

Grading of severity:

1 **Mild (grade 1):** Child is aware of, responds to, and can self-treat the hypoglycemia

2 **Moderate (grade 2):** Child cannot self-treat hypoglycemia and requires help from someone else, but oral treatment is successful.

3 **Severe (grade 3):** Oral treatment can't be applied; glucagon (at home) or IV glucose (in the hospital) is needed.

Treatment: The level of BG should be maintained above 4mmol/l.

- **Mild or Moderate (grade 1 or 2):**
- Immediate oral rapidly absorbed simple carbohydrate E.G., 5 – 15 g glucose or sucrose (tablets/ sugar lumps), 100ml sweet drink.
- Wait 10 – 15 minutes, if no response:
- Repeat Oral intake as above.
- A small snack (milk, sandwich ……..)
- Attempt to identify underlying cause.

B. Severe (grade 3)

- Treatment is urgent: may start at home but needs to come to hospitalAt Home:
  - Glucagon: 0.5mg (½ the ampoule) for age < 12 years.
    1.0 mg for age $\geq$12 years.
    or 0.1 – 0.2 mg/10kg body weight.

At Hospital:

-IV glucose should be administered slowly over several minutes:

0.5 g/kg glucose = 5 ml/kg 10% glucose(10% D 100 mg/ml).

- Recovery phase:
  - Close observation and BG monitoring.-Additional oral carbohydrate is required.-If oral intake is not possible give IV infusion of glucose 10% D
    2 – 5 mg/kg/min (1.5 – 3.0 ml/kg/h)
  - Think of the precipitating factors (insulin overdose, not eating, sickness) If no apparent cause found; consider adjusting insulin dose

Fulminant Hepatic Failure

Definition:
The development of signs of advanced liver failure such as hepatic encephalopathy which present within 8 weeks of the onset of liver disease, in the absence of previous liver disease.

Etiology:
Infections (CMV, EBV, hepatitis A B C, adenovirus, toxoplasmosis & others)Metabolic (galactosemia, tyrosinemia, wilson's & mitochondrial disease& others) Toxins &medications, autoimmune hepatitis, ischemia, malignancy and other.

Clinical manifestations:
Fever, jaundice, vomiting, abdominal pain, bleeding, ascitis, hepatosplenomegaly, encephalopathy.

Biochemical parameters:
- Hypoglycemia
- Electrolyte disturbance (hyponatremia, hypokalemia, hypocalcemia, hypomagnesemia)
- Acid-base disturbances
- Coagulopathy (prolonged PT, APTT, INR)
- Hypoalbuminemia & hypoprotinemia
- High ammonia, liver enzymes, bilirubin
- Renal failure

Follow up and monitoring:
- Liver function test (including glucose, albumin, coagulation, ammonia, bilirubin, ALT, AST, ALK, GGT) q12-24h; depend on clinical situation.
- Serum electrolytes and renal function
- CT head if suspecting cerebral oedema
- Head EEG for encephalopathy grading
- Abdominal U/S

Management:
- Assess ABCs and admit to ICU
  - Consult gastroenterologist on call
- Asses neurological status and level of consciousness (GCS≤ 7 need intubation and ventilation)
- **Fluids**: 2/3 maintenance, 10-20% **dextrose** according to blood glucose.
- Correct electrolyte disturbance, avoid hypertonic saline in hyponatremia, which can worsen hepatic encephalopathy

  Vitamin K$_1$: Infants 1-2 mg/dose IV, Children 5-10 mg/dose IV
- **Lactulose** (aim for 2 – 3 stools/day): Infants 2.5 ml q12h PO Children 5-10 ml q8h PO
- **Ranitidine** 2 – 4 mg/kg/day IV q12h
- IV antibiotics if indicated (not prophylactic)
- **Fresh frozen plasma** should only be given for DIC or who is actively bleeding; to avoid masking worsening liver function by correcting coagulation parameters.
- **Mannitol** infusion if ICP is suspected
- **N-acetylcystine** used for acetaminophen over dose and could be effective also infulminant hepatic failure from other causes.20% N-acetylcystine:

  150 mg/kg IV bolus in 3 ml/kg of D5%then 70 mg/kg in 3 ml/kg of D5% q4h x 12 doses to be given over 1 h

Upper Gastrointestinal Bleeding

Hematemesis is the passage of vomited material that is coffee grounds in colour or contains frank blood. Melena is the passage of black tarry stool results from bacterial degradation of hemoglobin.

Investigations:

- CBC, ESR
- Coagulation profile
- Liver function test

Etiology:

- Swallowed maternal blood (nipple fissure in breast feeding mother)
- Esophagitis, gastritis, duodenitis and stress ulcers
- Vascular malformation, aorto-esophageal fistula, esophageal varices
- Coagulopathy, Vitamin K deficiency
- Foreign body
- Non GI causes (hemoptysis)

Management:

- Check ABCs and give appropriate supportive care and monitoring
- Inform Pediatric gastroenterologist on call
- **For stable patients:**

  -NPO, start on IV fluids -IV ranitidine 3-4 mg/kg/day q6-8h, maximum: 50 mg/dose -Observe for 24 hours

- **For unstable patients:**

  -Admit to ICU
  -Cardio-respiratory monitoring
  -Two IV lines should be placed -urgent blood grouping and cross matching
  -Start **0.9% NS 20ml/kg bolus** and can be repeated till blood products are available (whole blood, packed RBCs, fresh frozen plasma)
  -NG normal saline lavage used to asses if the patient is continuing to bleed, and to be omitted if the source is esophageal varices
  -IV Ranitidine 3-4 mg/kg/day q6-8h, maximum: 50 mg/dose
  -Somatostatin or Octreotide
  Dose: 1 µg/kg IV bolus then 1 – 5 µg/kg/h IV continuous infusion diluted in D5W or NS
  Indications: patient with upper GI bleeding mainly secondary to esophageal varices or who is likely to have esophageal varices clinically.
  Mechanism of action: it is a long acting synthetic analogue of Somatostatin act by inducing relatively selective splanchnic vasoconstriction

-After stabilizing the patient, **Upper GI endoscopy** to be performed and to treat accordingly -If uncontrolled hemorrhage: urgent endoscopy should be performed for injection, heat probe laser, varical injection or ligation.

References:

1 Wyllie, Hyams. Pediatric Gastroentestinal Disease: 1999.
2 Walker, Durie, Hamilton, Walker Smith, Watkins. Pediatric Gastrointestinal Disease: 2000.
3 Hambidge Krebs, Seidman, Sokol etal. Pediatric Clinical Gastroenterology. Forth edition. 1995

Foreign Body (FB) Ingestion

- Foreign body ingestion can occur at any age (peak 6 months to 3 years)
- Most commonly reported foreign bodies are coins
- Radio-opaque FB found in 60-88%, most often due to coins
- Most non-opaque FB are due to retained food
- Most of the ingested FB pass through the GI tract and excreted without serious consequences

Predisposing factors:

- Anatomical abnormalities (esophageal stricture secondary to GERD, caustic ingestion and post esophageal atresia repair)
- Mental retardation, psychiatric disorder, and child abuse
- Motility disorder

Signs and symptoms:

- Chest pain, cough, wheezing, stridor, dyspnea, dysphagia, hypersalivation, hoarseness.
- Neck swelling, erythema, tenderness, crepitus
- Refuse to eat, vomiting, hematemesis, melena, abdominal pain, signs of peritonitis or bowel obstruction.

Complications: Failure to progress with mucosal ulceration, perforation, obstruction, fistula (TEF, EOF), hemorrhage, neck abscess, pneumothorax, pneumomediastinum, esophageal pouch.

Management:

- Check ABCs and stabilize the patient
- History & clinical examination
- Plain abdominal and chest X-ray A-P view to localize the FB
- Call gastroenterologist on call for any FB ingestion

Indication for FB removal and admission:

1 All esophageal FB

☐ 2. Gastric and duodenal FB if:

- Sharp, pointed objects
- Symptomatic
- > 5 cm in length & 3 cm in width
- Containing toxic substances
- Button batteries
- Blunt object remaining > 2 weeks in the stomach, > 1 week in the duodenum

When to refer to ENT:

- Fish/chicken bones in pharynx/ upper oesophagus
- Presence of FB in the larynx, upper airway

Evaluating child with fever

Fever is a common manifestation of illness in children including most of infectious diseases and some of non infectious diseases.

Fever is present when:

Oral temperature is 37.5C° or more.
Rectal temperature is 38C° or more.
Axillary temperature is 37.2C° or more.

Hypothermia	Normal body temperature	Fever	Hyperpyrexia

36.5 37.2 41

Hyperpyrexia is fever exceeding 41C°.

- For evaluation of a febrile child; detailed history and complete physical examination is important:

History taking:

Key paints in history:

-Fever, its duration and its pattern.
-Cough, running nose or difficulty in breathing
-Diarrhea or vomiting
-Sore throat - Earache
-Urinary symptoms: Dysuria, frequency.
-Headache, neck stiffness or convulsions
-Contact with infectious diseases
-Recent immunization

Physical examination.

Key points in examination:

-Degree of temperature
-General condition and level of consciousness
-Skin: for rash, abscess.
-Running eyes or nose
-Mouth: for follicular tonsillitis, dental abscess.
-Respiratory rate and any signs of Respiratory distress (e.g. pneumonia, broncheolitis)
-Joints and bone: swelling or tenderness e.g. Arthritis, osteomyelitis or malignancy.
-Abdomen for: splenomegaly
Tender liver (e.g. hepatitis)
Tender loin or supra pubic area (UTI)

****D.D of fever:***

- Infectious (the most common cause)	-Vaccination
-Tissue injury e.g. Burns, Hemorrhage to tissue.	-Malignancy
-Collagen disorder e.g. Rheumatoid arthritis	-Drug fever e.g. Antibiotics
-Allergy, transfusion reaction	-Familial Mediterranean fever
-Metabolic: e.g. Uremia, Gout.	-Factitious (self induced)

Management of a child with fever

↓ ↓

Measures to ↓ the temperature Treatment of the cause

↓ ↓

Fever with a focus Fever without a focus

i. *Measurements to decrease the body temperature:*

1) *Sponging with water*:

-A simple & rapid method.

-Use tepid water only.

-Don't use alcohol or cold water.

2) Medications:

→Paracetamol is the drug of the choice.

-Dose: 10-15 mg /kg /dose every 4-8 hrs.

→Ibuprofen: 5-10mg/kg/ose every 6-8hrs

N.B. Salicylates is prohibited as antipyretic in pediatrics

▼ ***3) other measures:***

-Extra fluid intake -light clothing

ii. ***Treatment of the cause of fever***:

a) IF there is a focus of infection:

E.g. Pneumonia, a cute follicular tonsillitis…etc

Give the appropriate antibiotic and consieler if the child in need for hospital admission or can treated as outpatient.

b) IF there is no focus of infection:

- If the child looks healthy with mild fever (<35C°) give Paracetamol and follow up for re-evaluation.

- IF the child looks ill →consider hospitalization for further assessment & investigations to reach the final diagnosis.

Community Acquired Pneumonia

Etiology:

- **Birth to 20 days:**
  GBS, gram negative enteric cocci and listeria monocytogenes
- **3 weeks – 3 months**:
  respiratory virus (RSV, influenza, parainfluenza, adeno, rhinovirus), chlamydia trachomatis, streptococcus pneumonia, bordetella pertussis, staphylococcus aureus, mycobacterium TB
- **months – 4 years**:
  respiratory viruses, streptococcus pneimonia, haemophilus influenzae,mycobacterium TB
- **5 – 15 years:**
  mycoplasma pneumoniae, chlamydia pneumoniae, streptococcus pneumoniae, mycobacterium TB

Investigations:

- CBC and differential, ESR/CRP, blood culture, CXR, ABG if in distress,
- If required nasopharyngeal aspirates for immunoflurescence for respiratory viruses (done at virology unit/faculty of medicine)
- Mycoplasma or chlamydia serology (Shaab virology)

Management:

- Check O_2 saturation. Aim > 92%
- Antibiotics: (7 - 10 days)
- **-Birth to 20 days**: Ampicillin 100-200 mg/kg/day q6h + Cefotaxime 150 mg/kg/day q8h
- **3 weeks – 3 months**: **afebrile pneumonia**: Erythromycine 40 mg/kg/day q6h
  febrile pneumonia: Cefotaxime 100-150 mg/kg/day q8h
- **months – 4 years**: Cefuroxime 100 mg/kg/day q8h
- **-5 years – 15 years:** Erythromycine IV/PO 40 mg/kg/day q6h OR
  Clarithromycin PO 15 mg/kg/day q12h OR
  Azithromycin PO 10 mg/kg/day q24h x 5 days

If febrile with high WBC add Cefuroxime 100 mg/kg/day q8h

References:

1 Macintosh K, Community Acquired Pneumonia in Children, *N Eng.J Med* 2002 ; 346:429-37.

2 Jadavji T, Law B. Label MH etal. A practical guide for the diagnosis and treatment of Paediatric Pneumonia. *Can Med Asso J* 1996; 156: S703 -11

Acute Meningitis

Etiology:

- Neonates: GBS, E.coli, Listeria monocytogenes
- 1 to 3 months: Streptococcus pneumoniae, N. meningitides, H.influenzae, GBS, Listeria monocytogenes.
- Beyond 3 months: Streptococcus pneumoniae, N. meningitides, H.influenzae
- Post craniotomy, V-P shunt: Coagulase negative staphylococci, Staph. Aureus, Pseudomonas aeruginosa.

Investigations:

- CBC, ESR/CRP, blood C/S, s. electrolytes, glucose.
- FDP, coagulation profile if suspecting DIC
- Lumbar puncture:

CSF:
- gram stain
- cell count: WBC and differential, RBC
- chemistry: glucose (compared with blood), protein
- C/S
- latex agglutination for Ag detection (if received antibiotics)
- if suspect TB: acid fast bacilli stain and mycobacterium TB culture
- if suspect viral encephalitis: send viral PCR to (HSV, VZV, CMV and enterovirus)
-always keep an extra tube of CSF for AFB and mycobacterium culture

Withhold LP if

- patient in cardio-respiratory compromise.
- Comatosed patient.
- Evidence of increased intracranial pressure.
- Platelets < 50 000 or bleeding diathesis

CT head is indicated if

- Focal neurological signs
- Prolonged convulsions
- Impaired level of consciousness
- Evidence of increased intracranial pressure

	Normal child	Normal neonate	Bacterial	viral	TB	Partially treated
WBC	< 5	<22	300-2000	Increased rarely >1000	10-500	300-2000
Predominant cells	> 75% lymphocytes	Polymorphs + lymphocytes	polymorphs	Early: polymorphs then lymphocytes	lymphocytes	Polymorphs or lymphocytes
Glucose	> 50%	> 50%	Low	normal	Very low	Low or normal
Protein mg/l	200-450	200-1700	High	Normal or slightly high	Very high	high

Management:

- Check ABCs
- Restore circulating volume and urinary output as priority.
- Monitor vital signs, hydration and neurological status
- If impaired consciousness keep patient NPO
- Start antibiotics after collecting cultures as soon as possible
- **Full term neonates < 1 week:**

  Ampicillin 150 mg/kg/day IV q8h + Cefotaxime 150 mg/kg/day IV q8-12h -1 week
- **3 months:**

  Ampicillin 200 mg/kg/day IV q6h + Cefotaxime 200 mg/kg/day IV q6h –
- **Children > 3 months**:

  Cefotaxime 200 mg/kg/day IV q6h

Add

Vancomycin 60 mg/kg/day IV q6h if:

1. Gram stain showing gram positive cocci

OR

2. very ill child with hemodynamic instability

Once the organism and sensitivities is recognized, switch to appropriate and narrowest spectrum antibiotic.

- **Supportive care and monitoring**-Input and output chart + weight-Daily head circumference-Watch for SIADH (urine specific gravity & serum Na)-IV fluids: maintenance (if SIADH restrict to 2/3 maintenance)-Anticonvulsant: if convulsions.
- **Duration of antibiotics:**

Neonates:	2 weeks (3 wks if gram negative)
S.Pneumoniae:	10 – 14 days
H.fleunzae:	7 – 10 days
N.meningitides:	5 – 7 days
Gram negative:	3 weeks

Choking

- 90% of deaths from foreign body aspiration occur in children <5 years of age.
- Liquids are the most common cause of choking in infants.
- Balloons, small objects, and foods are the most common in children.

Symptoms and Signs:

Sudden onset of respiratory symptoms and signs in a proper setting is characteristic of foreign body airway aspiration.

- **FB in upper airway**: Respiratory distress, coughing, gagging, stridor, hoarseness of voice, wheezing, and cyanosis
- **FB in lower airway**: cough, respiratory distress, asthma like symptoms not responding to treatment

Management:

- **Mild obstruction** (can cough and make some sounds)
    - Do not interfere
    - Allow the patient to clear the airway by coughing while you observe for signs of severe airway obstruction.
- **Severe obstruction** (cannot cough and unable to make any sound)

1. An infant: (Figure 1)

- Place the infant in 60° head down position, lying on your forearm.
- Deliver 5 back blows (slaps) between the shoulder blades with the heel of your hand followed by 5 chest thrusts (as with cardiac compression) repeatedly until the object is expelled or the patient becomes unresponsive.
- Abdominal thrusts are not recommended for infants because they may damage the relatively large unprotected liver.

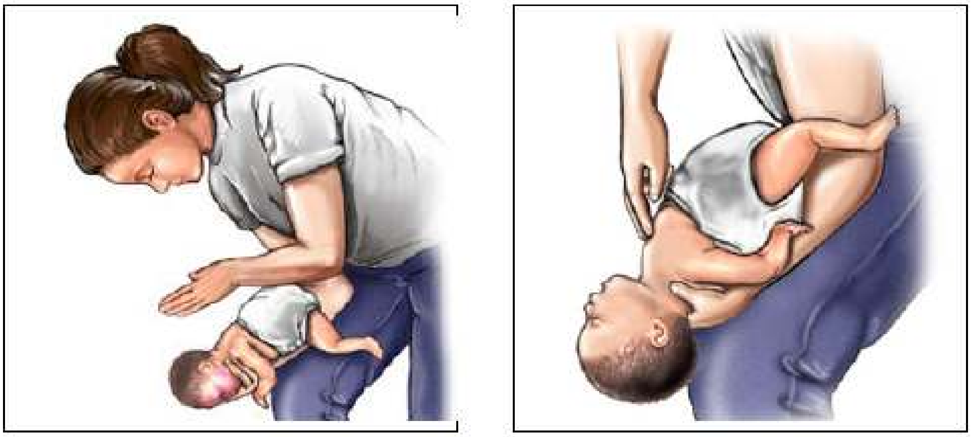


Figure 1

\

2. A child: (Figure 2)

- Perform subdiaphragmatic abdominal thrusts in standing position (Heimlich maneuver) or place the heel of one hand on the abdomen between the umbilicus and the rib cage in a supine position until the object is expelled or the patient becomes unresponsive.

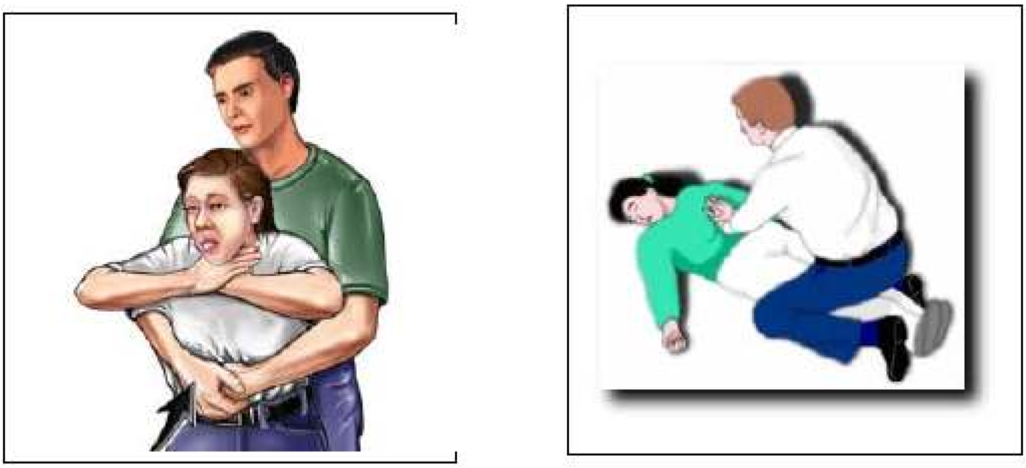


Figure 2

Unresponsive patient

- If you see a foreign body in the mouth, remove it.
- Do not perform blind finger sweeps because you may push obstructing objects further into the pharynx and may damage the oropharynx.
- Perform CPR and attempt ventilation. If ventilation is not possible, repeat above maneuvers.

NB. The above maneuvers should be done until experienced personal in airway is present.

Hyper-cyanotic spell

Hypercyanotic spell (also called hypoxic spell, cyanotic spell, "tet" spell) of tetralogy of fallot requires recognition and treatment, as it can lead to serious CNS complications. It occurs in young infants, with peak incidence between 2 and 4 months of age.

It is characterized by:

1. A paroxysm of hyperpnea (rapid and deep respiration).
2. Irritability and prolonged crying.
3. Increasing cyanosis 4-decreased intensity of the heart murmur.

These spells usually occur in the morning after crying, feeding, or defecation. A severe spell may lead to limpness, convulsion, cerebrovascular accident and even death.

Pathophysiology of hypercyanotic spell

In tetralogy of fallot, the right ventricle (RV) and left ventricle (LV) can be considered as a single pumping chamber, since there is a large V.S.D equalizing pressures in both ventricles. Lowering of the systemic vascular resistance (SVR) or increasing resistance at the right ventricular outflow tract (RVOT) can increase the right–lift shunting, and this in turn stimulate the respiratory center to produce hyperpnea. Hyperpnea results in an increase in systemic venous return, which in turn increases the R-L shunt through the V.S.D., as there is an obstruction at the RVOT. A vicious circle becomes established.

Treatment

One or more of the following may be employed in decreasing order of preference:

1. Pick up the infant and hold in a knee-chest position.

2. Morphine sulfate, ***0.1 to 0.2 mg/kg Sc or IM,*** suppresses the respiratory center and abolishes hyperpnea. Do not try to establish an IV line initially, use the subcutaneous route for morphine.

3. Treat acidosis with sodium bicarbonate, ***1 mEq/kg IV***. This reduces the respiratory center-stimulating effect of acidosis. Recovery from the spell is usually rapid once the pH return to normal, but pH follow up is essential for fear of recurrence of acidosis.

4. Oxygen inhalation has only limited value.

With this treatment the infant usually becomes less cyanotic and the heart murmur becomes louder.

If not fully responsive with the above measures:

5. Ketamine, ***1 to 3 mg/kg*** (average of 2mg/kg) in a slow IV push

6. Vasoconstrictors, such as phenylephrine (Neo-synerphrine), ***0.02 mg/kg IV*** may work by raising the SVR and forcing more blood to the lungs.

7. Propranolol, ***0.01 to 0.25 mg/kg*** (average 0.05 mg/kg) in a slow IV push, reduce the heart rate and may reverse the spell.

Prevention

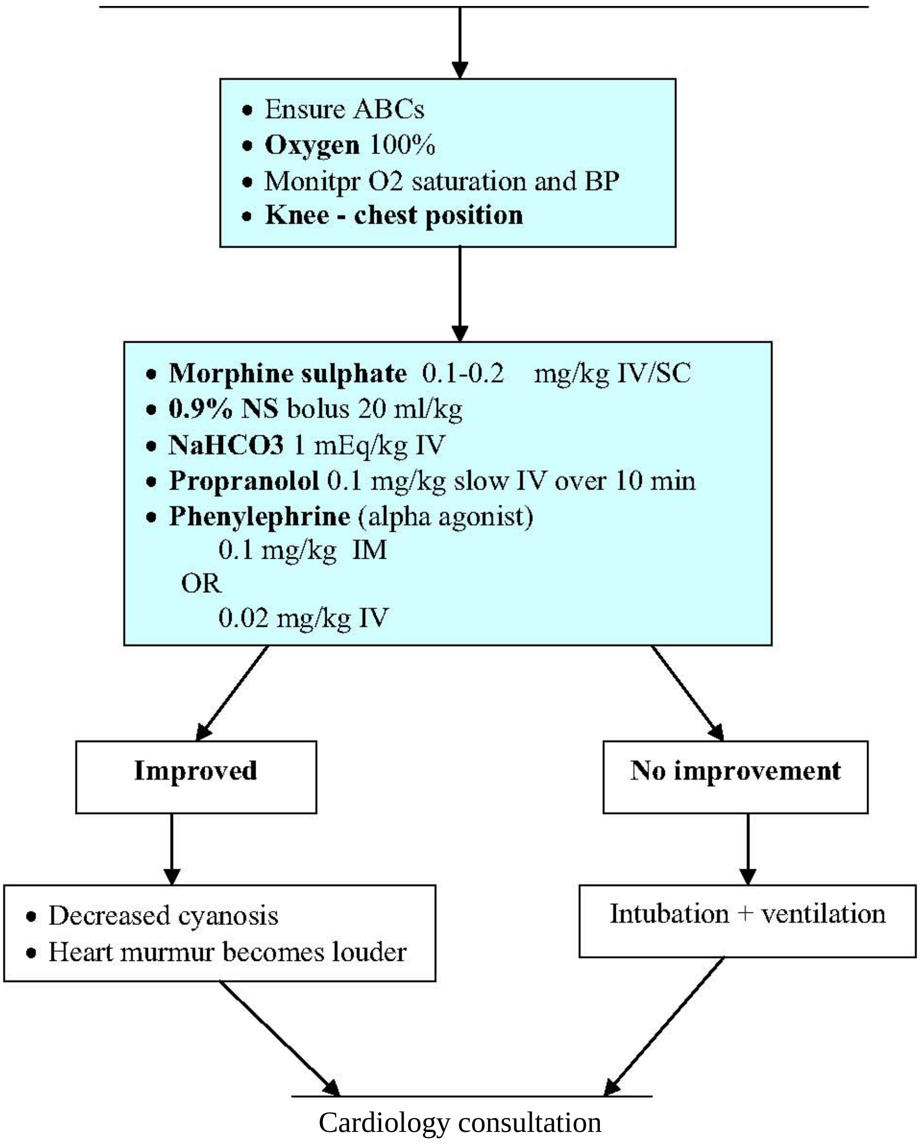
- Oral propranolol, **2 to 4 mg/kg/day** may be used to prevent hypoxic spells and delay corrective therapy. The beneficial effect of propranolol may be related to its stabilizing action on peripheral vascular reactivity.

N.B.:	*Morphine amp.*	*1mg/1ml (1ml)*
	Ketamin (ketalar) amp.	*50mg/1ml (10ml)*
	Propranolol (inderal) amp.	*1mg/1ml (1ml)*
	Phenylephrine amp.	*Not available*

Management of Cyanotic Spell

Clinical manifestation:

- Cyanotic spell observed in children with TOF
- Peak between 2-4 months
- Usually occurs in morning
- Irritability, diaphoresis, inconsolable crying increased cyanosis
- CVS: tachycardia, decreased in intensity/disappearance of murmur
- Respiratory: tachypnea, grunting, hyperpnea, respiratory distress
- CNS: seizures, coma


• Ensure ABCs
• **Oxygen** 100%
• Monitpr O2 saturation and BP
• **Knee - chest position**
• **Morphine sulphate** 0.1-0.2 mg/kg IV/SC
• **0.9% NS** bolus 20 ml/kg
• **NaHCO3** 1 mEq/kg IV
• **Propranolol** 0.1 mg/kg slow IV over 10 min
• **Phenylephrine** (alpha agonist)
0.1 mg/kg IM
OR
0.02 mg/kg IV
Improved
No improvement
• Decreased cyanosis
• Heart murmur becomes louder
Intubation + ventilation
Cardiology consultation

Acute Pallor

Causes:

1. Acute blood loss	***2. Acute hemolytic anemia***
- Traumatic bleeding	- Hemolytic cries of G6PD deficiency
- Surgical bleeding	- Crises of chronic hemolytic anemias
- Gastrointestinal bleeding	- Hemolytic uremic syndrome
- Bleeding disorders	- Hemolytic anemia of infections
* Purpuras	- Acute autoimmune hemolytic anemia
* Coagulation defects	- Metabolic hemolytic anemia
	* Erythrocytic porphyria
	* Wilson disease

- Acute form of:

* Paroxysmal nocturnal hemoglobinuria
* Hereditary spherocytosis

1. Hemolytic crisis of G6PD deficiency

- Acute hemolytic crisis occurs on exposure to oxidant materials especially certain drugs and foods
- Infections also bacterial or viral may induce hemolysis

Drugs and foods that induce hemolysis in G6PD deficiency

Drugs:

- Antipyretics as acytylsalicylic acid (Aspirin) and metamizole (Novalgin).
- Antibiotics as chloramphenicol, nalidixic acid, sulphonamides, antimalarial drugs, furazolidone.

Foods:

Broad beans and its products, fava beans (Favism) is also potent oxidant other beans as greens beens and peas may be also responsible.

2. Crises of chronic hemolytic anemias

a) Aplastic crisis

- It is a self limited attack which usually lasts 10-14 days.
- Diagnosis depends on the presence of acute severe anemia and reticulocytopenia in a known case of chronic hemolytic anemia.

Bone marrow examination reveals a diminished red cell precurosors.

b) Hyperhemolytic crisis

- It is characterized by acute hemolytic episode with intense pallor, jaundice, and dark urine (hemoglobinuria)
- Reticulocytosis

c) Sequestration crisis:

- Caused by sudden pooling of large amount of blood into the liver and spleen → tender hepatosplenomegaly and manifestations of hypovolemic shock.

d) Vaso-occlusive (painful) crisis

- Painful swellings of hands and feet (hand-food syndrome) and painful swellings of large joints. It occurly mainly in sickle cell anemia and not associated with intense pallor but mentioned for comparison with other crises.

3. Hemolytic uremic syndrome

- It is a syndrome of acute hemolytic anemia, acute renal failure, thrombocytopenia and distorted red cells.

- ***Clinically:*** acute intense pallor, hematuria and oliguria and purpura are usually present.

D.D.:

- Bilateral renal vein thrombosis, D.I.C,
- Septicemia, thrombotic thrombocytopenic purpura

4. Hemolytic anemia of infection

- Septicemia and malaria can produce direct hemolysis by the organisms or their toxins

- With septicemia, the patient is critically sick, thrombocyto-penia and acute renal failure may also occurred, organisms e.g. malaria, clostridia, meningococcal sepsis.

5. Immune hemolytic anemia

- Autoimmune (Warm antibody type, cold antibody type)
- Alloimmune:
  - Hemolytic transfusion reactions
  - Hemolytic disease of newborn
  - Allografts, especially marrow transplantation
- Drugs associated

Clinical manifestations

- Acute intense pallor due to acute hemolysis
- Acute jaundice due to unconjugated hyperbilirubinemia
- Manifestations of acute hypoxia (tachycardia, tachypnea and altered consciousness) in severe cases
- Fever may be also present.

Laboratory findings

1. Features of increased red cell breakdown

a) Serum bilirubin raised, unconjugated and bound to albumin

b) Increased urine urobilinogen

c) increased faecal stercobilinogen

d) Absent serum haptoglobins

2. Features of increased red cell production:

a) Reticulocytosis

b) bone marrow erythroid hyperplasia

3. Damaged red cells

a) Morphology- Microspherocytes, elliptocytes, fragments, etc.,

b) Osmotic fragility, autohemolysis, coomb's test, etc.,

c) Red cell survival shortened, this is best shown by ^{51}cr labeling with study of the sites of destruction.

4. Evaluation of renal function: with suspected hemolytic uremic syndrome

5. Others:

CRP in cases of suspected sepsis, film for malaria, serum ceruloplasmin, G6PD enzyme activity 3 weeks after the acute episode.

Treatment of Acute Pallor

1. **In crisis of G6PD deficiency**
   - The offending drugs is stopped, any underlying infection is treated, a high urine output is maintained and blood transfusion were necessary for severe anemia.
   - G6PD deficient babies are prone to neonatal jaundice and in severe cases phototherapy and exchange transfusion may be needed the jaundice is usually not caused by excess hemolysis but by deficiency of G6PD affecting neonatal liver function.

2. **Crises → treat by rest, warmth, rehydration by oral fluids and/or I.V. normal saline**
   - Antibiotics if fever > 39°C ceftriaxon (Rocephin) I.V.
   - Analgesia e.g. paracetamol, a non steroidal anti-inflammatory agent.
   - Blood transfusion is given only if there is very severe anemia with symptoms**.**
   - Exchange transfusion may be needed particularly if there is neurological damage, a visceral sequestration crisis or repeated painful crisis.

3. In hemolytic-uremic syndrome

- Aggressive management of A.R.F.
- Heparin - F.F. plasma - Long term observation

4. In immune hemolytic anemia

- Remove the underlying cause e.g. methyldopa, fludarabine.
- Blood transfusion therapy, only packed cells should be used 50 ml/m^2/transfusion.
- ***Corticosteroids:*** Acute episode I.V. hydrocortisone 200 mg/m^2/day for first 24-48h. Then oral prednisone.
- Oral prednisone 2mg/kg/24hrs up to 6mg/kg/d. In 3-4 doses up to Hb% stabilizes at 10 gm/dl and ↓ retics.
- Gradual tapering over 2 months, during which it can be given every other day.

* Plasma pheresis

* Splenectomy indicated in:

  - Cases refractory to steroid therapy
  - Cases in need of large dose of steroid

*Immunosuppresive agents → in patients refractory to steroids, plasma pheresis, and splenectomy

* High dose of immunoglobulin

* Folic acid

* Thymectomy

Oliguria

Definition: urine output less than 1 mL/kg/hr or daily urine volume is less than 400 mL/m^2/day.

* So accurate urine collection is mandatory to establish the diagnosis.

Evaluation of the child with oliguria :

Oliguria may be the early manifestation of ARF beside the original cause manifestations so good suspicion is important.

1st. Diagnosis of acute renal failure : Depends on a combination of clinical manifestations and laboratory findings.

1. Clinical manifestations which include : the manifestations of the causative disease (dehydration) or of renal failure (severe oliguria, edema, hypertension, pallor and acidotic breathing) or the complications (congestive heart failure, pulmonary edema, cardiac arrhythmias, convulsions, gastrointestinal bleeding, or uremic encephalopathy).
2. Laboratory diagnosis :

- Elevated levels of blood urea and serum creatinine.
- Metabolic acidosis (low pH and bicorbonate).
- Electrolyte disturbance (hyperkalemia, hyperphosphatemia, hypocalcemia, hyponatremia).

2nd. Diagnosis of the cause :

1. Clinical manifestations : of prerenal causes (dehydration, hemorrhage, burns, shock, respiratory failure), renal causes (hematuria, pupura, acute hemolytic anemia) or postrenal causes (flank masses).
2. Laboratory diagnosis : several investigations are usually needed to identify the cause especially in renal and postrenal causes (CBC, CRP, urine analysis and culture, and abdominal ultrasound).

Management:

1st. clinical and laboratory monitoring as level of consciousness vital signs, state of hydration, urine output, weight, continuous ECG, repeated blood gases and urea, serum electrolytes and creatinine.

2nd. Conservative measures :

1. Treatment of oliguria :

One. Volume expansion : In all cases except those with fluid overload and hypervolemia (intravenous administration of isotonic saline 20 mL/kg over 30 min).

Two. Diuretic therapy : Furosemide in a single I.V dose of 2 mg/kg at rate of 4 mg/min, if no response, 2nd dose of 10 mg/kg, if no response, no more. Manitol may be given as single IV dose of 0.5-1 gm/kg over 30 min.

Three. Dopamin infusion. 2 µg/kg/min.

Four. Fluid restriction : Indicated in patients who failed to obtain an adequate urine flow following volume expansion, diuretics and dopamin. The daily fluid volume = urine output + 400 ml/m^2/day.

2. **Treatment of metabolic acidosis** : Indicated when $pH < 7.15$ and serum bicarbonate < 8 mEq/L . I.V mEq sodium bicarbonate required = 0.3 x wt (kg) x (12 – serum bicarbonate mEq/L).
3. **Treatment of hyperkalemia :**

One. Restriction of K intake.
Two. Oral or rectal sodium polystyrene sulfonate resin in a dose of 1 gm/kg.
Three. Calcium gluconate 10% solution : 0.5 mL/kg IV over 10 min.
Four. $NaHCO_3$: 3 mEq/kg I.V slowly.
Five. Glucose 50% solution (1 mL/kg) with regular insulin (1 unit/5gm glucose).
Six. Dialysis is indicated if these measures fail to reduce K and the level > 7 mEq/L.

4.**Treatment of hyponatremia** : If serum Na level is less than 120 mEq/L where hypertonic (3%) sodium chloride given I.V.

mEq Nacl required = 0.6 x wt (kg) x (125-serum Na mEq/L).

5. **Treatment of hypertension** : In mild cases (salt and water restriction, furosemide, β-blocker (propranolol: 1-3 mg/kg/12 hr po) but in severe cases (Diazoxide is the drug of choice given I.V, 1-3 mg/kg, sublingual nifedipine 0.25-0.5 mg/kg/dose or continuous IV infusion of nitroprusside may be given).
6. **Treatment of convulsions** : Diazepam given I.V in a dose of 0.3-0.5 mg/kg/dose.
7. **Treatment of anemia** according to the cause.
8. **Control of infection** if present with precuations as regards to the type, dosage and duration of the selected antibiotic.
9. **Dialysis** : It is indicated in cases with :

One. BUN more than 100 mg/dL.
Two. Serum K more than 7 mEq/L not controlled by other measures.
Three. Serum Na : marked hypo or hypernatremia.
Four. Serum pH : intractable severe metabolic acidosis not corrected $NaHCO_3$.
Five. Fluid overload: with uncontrolled hypertension, congestive HF and pulmonary edema.

Acute retention of urine

Definition : It is a failure to obtain urine from the external urethral meatus inspite of normal glomerular filtration rate due to obstructing agent.

- Dullness in suprapubic region (full bladder) plus anuria suggest the diagnosis.
- Urology surgical consultation is mandatory to asses the condition and to relief the retention (by uretheral or suprapubic catheter).

Hematuria

Definition : It may be gross and identified by naked eye or microscopic where there is more than 5 RBCs per high power field in the sediment from 10 mL of centrifuged freshly voided urine.

* So urine analysis is mandatory to establish the diagnosis and exclude other causes of dark urine.

Evaluation of the child with hematuria :

1. History:

- A history of recent upper respiratory, skin, or GIT infection may suggest acute glomerulonephritis, or the hemolytic-uremic syndrome.
- Unexplained fever, dysuria and frequency suggest urinary tract infection.
- History of trauma, bleeding tendency, or of drug use.

- Recurrent episodes of gross hematuria suggest IgA nephropathy, idiopathic hematuria, Alport syndrome, or hypercalciuria.

2. Physical Examination :

- **Flank mass :** Hydronephrosis, cystic disease, renal vein thrombosis, or tumor.
- **Rash and joint pains :** Anaphylactoid purpura, or lupus.
- **Hypertension :** Acute glomerulonephritis, lupus, or any severe renal disease.

3. Laboratory evaluation :

Step 1 : Studies performed in all patients :

Complete blood count, urine culture, serum creatinine level, 24 hr urine collection for (creatinine, protein and calcium), serum C3 level, ultrasonography or intravenous pyelography.

Step 2 : Studies performed in selected patients :

DNase B titer or streptozyme test if hematuria is of < 6 mo duration, skin or throat cultures when appropriate, ANA titer, urine erythrocyte morphology, coagulation studies/platelet count when suggested by history, sickle cell screen in all black patients, voiding cystourethrography with infection or when lower urinary tract lesion is suspected.

Step 3 : Invasive procedures :

A. Renal biopsy is indicated for :

Persistent high-grade microscopic hematuria.

Microscopic hematuria plus any of the following : diminished renal function or proteinuria (> 150mg/day) or hypertension.

Second episode of gross hematuria.

B. Cystoscopy is indicated for

Pink to red hematuria, dysuria, and sterile urine culture.

Treatment :

1. Observation :
- Urine : volume, specific gravity and proteinuria daily.
- Blood pressure.
- ECG (hyper K).
- Serum electrolytes, BUN, serum creatinine and pH.

2. Rest : It is necessary in cases of ARF and HF.
3. Diet :

Fluid Na, K and protein restriction especially if ARF present.

Calories in sufficient amount in the form of carbohydrate.

4. Treatment of the cause.
5. Treatment of complications of ARF (if present) as : hypertension, hypo Na, hyper K, metabolic acidosis .. etc.

Assessment of Child with Poisoning

-Accidental poisoning is common in children under the age of 5 years.

-The assessment of a poisoned child **aimed to know:**

- What is the poison.
- The amount ingested
- Whether there is a specific management.

*Detailed history from the parents and other relatives& complete physical examination are done **with special attention to :***

- Level of consciousness.
- Circulation: Heart Rate and blood pressure
- Respiration: Rate and pattern
- Neurological system.
- Pupils: size, reactivity
- Odour of breathing

Management of a Child with poisoning

The management is always an emergency as follow:

1. Emergency measures: ABC (Airway, Breathing, Circulation) I.V. line.
2. Removal of Gastric contents by:
   - -Induction of Vomiting:
     by Ipecac syrup 10-15ml in a glass of water or saline.
   - -Gastric lavage: by Nasogastric tabe
3. Adsorption of poison:
   - -Activated charcoal in a dose of 15-30g orally.
4. Increasing the intestinal emptying:
   e.g. Magnesium sulphate
5. Antidote: if there is a specific known antidote.
6. Supportive measures:
   I.V. fluids, electrolytes balance, adequate nutrition
   and treatment of infection.

***Contraindication for induction of vomiting and gastric lavage:**

- Corrosives e.g. Potash
- Volatile substances e.g. kerosene
- Impaired level of consciousness

Some Specific Antidotes

Poison	Antidote	Dose
Organophosphates	Atropine	0.05mg/kgdose
Narcotics	Naloxone	0.01mg/kgdose
Paracetamol	Acetylcystine	loading:140mg/kg Maintanance10mg/kg/4hrs
Lead. Mercury	BAL	3-5mg/kg/4hrs
Isoniazid	Pyridoxine	25mg/kg
Iron	Deferoxamine	15mg/kg/hr
Metoclopramid	Diphenhydramine	5mg/kg/8hrs

Management of some common poisons in Egypt

1. ***Organophosphates& carbamates***

Examples: most of insecticides; DDT and Toxaphene

***Clinical picture:**

- Parasympathetic manifestation: salivation, lacrimation, bronchospasm, increased bronchial secretions, bradycardia and ***miosis*** (is characteristic)
- Muscle cramps, weakness, areflexia, pallor, hypertension
- C.N.S manifestations: restlessness, headache, drowsiness ataxia, generalized weakness, convulsions and coma.

****Management:***

- General rules of poisoning treatment.
- Induction of vomiting &stomach wash
- Atropine sulphate:
  Initial dose 0.05mg/kg I.V. then a maintenance dose
  of 0.02-0.05mg/kg every 10-30 minutes
- Cholinesterase reactivators:
  e.g. pralidoxime:20-50mg/kg I.V. in saline infusion.
- Decontamination of the skin with soapy water.

2. *Corrosives poisoning*

Example:

Alkali (caustic potash) or Acids (phenol)

Clinical picture:

-Corrosion of the mouth, throat and oesophagus.

-Epigastric pain, dysphagia, nausea or vomiting

**Management:*

-Induction of vomiting or gastric lavage is ***contraindicated*** as it many lead to perforation

-Water or milk is given immediately to dilute the ingested corrosive.

-Egg white or starch as demulcents.

-Parental analgesia.

-Prophylactic corticosteroids to prevent late fibrosis or stricture formation.

-Antibiotics to prevent infection.

-Upper endoscope in ist 24 hours to assess the extent of damage.

-Surgical management of late stricture.

3. *Hydrocarbons poisoning*

E.g. Kerosene

Clinical picture:

- Initial burning sensation in the mouth and throat followed by choking and cough.
- Respiratory affection: Respiratory distress, cyanosis or grunting.
- Fever.
- In severe cases; weak irregular pulse, weakness, confusion, convulsions or coma.

Management:

- Emesis or stomach lavage is ***contraindicated***
- Supportive measures.
- Corticosteroids is contraindicated
- Antibiotics if there is an evidence of infection.

ABDOMINAL PAIN

Acute pain

1. *Approach to the patient with acute abdominal pain*.

The most urgent consideration in evaluating a child with acute abdominal pain is to determine whether there is an under- lying cause requiring surgery. Most causes of abdominal pain in children do not require surgical treatment, although such causes of pain are more common in children younger than 2 years of age. Sources of pain outside the abdominal cavity (e.g., lower lobe pneumonia) must be considered in the evaluation.

A. Important causes of abdominal pain possibly requiring surgery (the acute abdomen)

(1) Intestinal obstruction due to malrotation and volvulus, intussusception, strangulated hernia, or adhesions

(2) Appendicitis, Meckel diverticulum, or an abdominal abscess

(3) Toxic megacolon

(4) Perforated duodenal ulcer or perforation of intestine secondary to another process

(5) Cholecystitis

(6) Rupture of the spleen or other organ due to trauma

B. Clinical features suggesting a cause requiring surgery

(1) Vomiting, especially if it is bilious or feculen

(2) Sudden onset of abdominal distention

(3) Absent bowel sounds or high-pitched sounds suggestive of intestinal obstruction

(4) Abdominal signs of peritonitis (e.g., rigidity, guarding, rebound tenderness)

Important causes of acute abdominal pain not requiring surgery

(1) Enteritis; colitis of any cause

(2) Henoch-Schonlein purpura, hemolytic-uremic syndrome, and other types of vas- culitis

(3) Fecal impaction

(4) Hepatitis

(5) Pancreatitis

(6) Vasoocclusive crisis of sickle cell anemia

(7) Primary peritonitis

(8) Mesenteric adenitis

(9) Urinary tract infection or urinary calculi

(10) Entra-abdominal causes (e.g., pneumonia, osteomyelitis, acute neurologic processes)

(11) Unusual causes [e.g., porphyria, familial Mediterranean fever, diabetic ketoaci- dosis, lead poisoning, Kawasaki disease (gallbladder hydrops)]

Intussusception:

is the invagination of one part of the intestine into another. It is one of the most common causes of intestinal obstruction in infancy.

b. Clinical features

{1) Bouts of irritability and colicky pain start suddenly. Vomiting is common. Rectal bleeding may occur but only rarely in the form of the classic "currant jelly" stools {i.e., stools containing red blood and mucus).

(2) The degree of lethargy demonstrated by the child may be striking. At times the prominent presenting feature may be "altered consciousness."

(3) A tubular mass is palpable in about half of the patients

c. Diagnosis

(1) A plain abdominal film may show a paucity of gas in the right lower quadrant ot evidence of obstruction.

(2) A barium enema demonstrates a coiled-spring appearance to the bowel, which is diagnostic.

d. Therapy

(1) Hydrostatic reduction by careful barium enema performed by an experienced radiologist is successful in about 75% of cases. Peritoneal signs or the presence of pcritoneal free air are an absolute contraindication to this procedure.

(2) Surgery is indicated when hydrostatic reduction is inappropriate or unsuccessful.

Procedures

Intraosseous Access (IO)

- IO is required in life-threatening situations
- IO is indicated when intravenous access fails (3 attempts or >90 seconds).
- Can be used for administration of Crystalloids, colloids, blood products and drugs.
- IO may be left in place for 72-96 hours.
- Remove IO as soon as intravenous access has been established.

Contraindications:

- Ipsilateral fracture (risk of extravasation and compartment syndrome).
- Previous attempt or placement of IO in the same leg (risk of extravasation)
- Osteogenesis imperfecta (risk of fracture)
- Osteopetrosis (risk of fracture)
- Obvious overlying infection (a relative contraindication)

Procedure:

A. Proximal tibia (Fig.1)

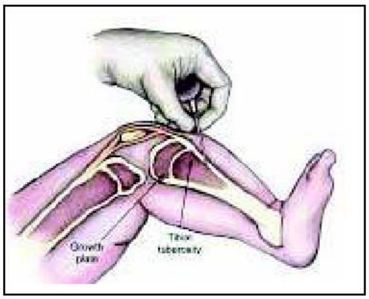
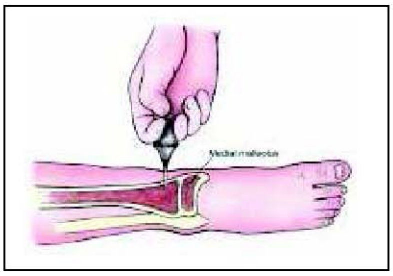


Figure 1. IO in Proximal tibia

1 Strict aseptic technique
2 ± Local infiltration with 1 – 2 ml of 1% lidocaine
3 Flex the knee and put a towel roll or a sandbag as support behind the knee.
4 hold the stylet ball in the palm of your hand, and place the tip of your index finger 1- 1.5 cm from the tip of the needle
5 Insert the IO needle 1-3 cm below the tibial tuberosity on the anteromedial surface of the tibia. at 90 degrees to the skin (perpendicular) and slightly caudal (towards the foot) to avoid the epiphyseal growth plate.
6 Advance the needle using a screwing motion until a 'give' is felt when the needle penetrates the cortex of the bone.
7 Correct placement of IO needle is confirmed by the aspiration of blood and marrow, if it stands upright without support and the infusion flows smoothly.

B. Other sites

☐ Distal tibia (Fig.2)
☐ Distal femur (Fig.3)



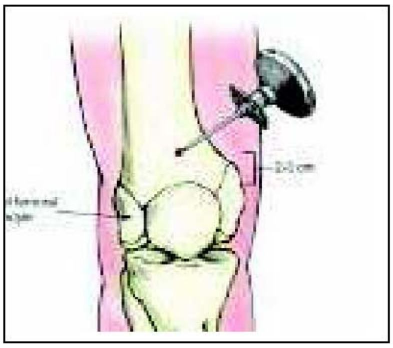


Figure 2. IO in Distal tibiaFigure 3. IO in Distal femur

Complications:

- Local infection (cellulites, osteomyelitis)
- Compartment syndrome secondary to fluid extravasation
- Local hematoma�Pain
- Potential for growth plate injuries
- Fat embolus& Bone embolus, although not reported in humans

References:

1 Eric V, Anamaria B, Peter R, Xavier L. *Update in Anesthesia.* Issue 12 (2000) Article 10:1.
2 Barkin R, Rosen P. *Emergency A Guide to ambulatory Care*: fifth edition 1999.
3 Pegeen E. Intraosseous Access. October 2004.*emedicine.com.*

Lumbar Puncture (LP)

Contraindications:

1 Signs of raised intracranial pressure (unequal pupils, rigid posture or paralysis, irregular breathing).
2 Lateralizing neurological findings or papilledema.
3 Patient is unstable (in cardio-respiratory compromise).
4 Skin infection in the area through which the needle will have to pass.
5 Bleeding diathesis, thrombocytopenia (< 50,000)

Procedure:

- Proper positioning and adequate restraint of patient is essential to a successful tap.
- Place patient with back fully flexed and either lying on one side or sitting up with hips, knees, and neck flexed (figure 1,2). Make sure that the child can breathe normally.

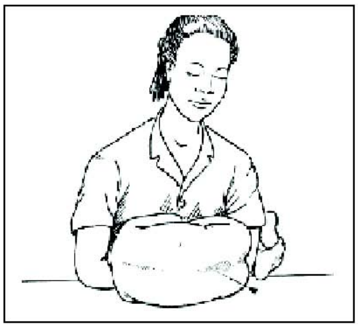
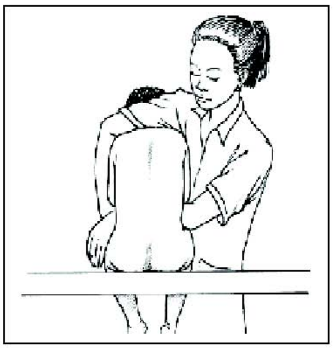


Figure 1



.Figure 2.

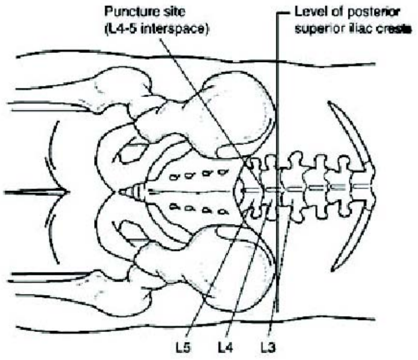
Locate the space between L3-L4 (at the junction of the line between the iliac crests and the vertebral column). or between L4-L5. (figure. 3)Avoid L2-3 space in infant (cord lower than in older child).

- Use aseptic technique. Scrub the hands and wear sterile gloves. Prepare the skin around the site with an antiseptic solution. Sterile towels can be used. May infiltrate the skin and subcutaneous tissue with 1 % lidocaine (not in neonates).
- Use an LP needle with stylet (22 gauge for a young infant, 20 gauge for an older infant and child). Insert the needle into the middle of the intervertebral space and aim the needle towards the umbilicus. Advance the needle slowly until a “pop” is felt, withdraw the stylet, and cerebrospinal fluid will drop out of the needle.

Collect CSF in appropriate tubes. If no cerebrospinal fluid is obtained, the stylet can be reinserted and the needle advanced slightly.

- Withdraw the needle completely and put pressure over the site for a few seconds. Put a sterile dressing over the needle puncture site.
- If the needle is introduced too far a lumbar vein may be punctured. This will result in a "traumatic tap" and the spinal fluid will be bloody. The needle should be withdrawn and the procedure repeated in another intervertebral space.

(Figure.3)



Anatomy of lumbar spine showing sites for dural puncture

Complications:

- The use of needles without a stylet has an associated risk of spinal epidermoid tumours.
- Postlumbar puncture headache occurs in 10% to 30% of patients.
- Risk of infection (theoretical).

Blood Pressure Levels for Boys by Age and Height Percentile

Age (Year)	BP Percentile ↓	Systolic BP (mmHg)							Diastolic BP (mmHg)						
		← Percentile of Height →							← Percentile of Height →						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
1	50th	80	81	83	85	87	88	89	34	35	36	37	38	39	39
	90th	94	95	97	99	100	102	103	49	50	51	52	53	53	54
	95th	98	99	101	103	104	106	106	54	54	55	56	57	58	58
	99th	105	106	108	110	112	113	114	61	62	63	64	65	66	66
2	50th	84	85	87	88	90	92	92	39	40	41	42	43	44	44
	90th	97	99	100	102	104	105	106	54	55	56	57	58	58	59
	95th	101	102	104	106	108	109	110	59	59	60	61	62	63	63
	99th	109	110	111	113	115	117	117	66	67	68	69	70	71	71
3	50th	86	87	89	91	93	94	95	44	44	45	46	47	48	48
	90th	100	101	103	105	107	108	109	59	59	60	61	62	63	63
	95th	104	105	107	109	110	112	113	63	63	64	65	66	67	67
	99th	111	112	114	116	118	119	120	71	71	72	73	74	75	75
4	50th	88	89	91	93	95	96	97	47	48	49	50	51	51	52
	90th	102	103	105	107	109	110	111	62	63	64	65	66	66	67
	95th	106	107	109	111	112	114	115	66	67	68	69	70	71	71
	99th	113	114	116	118	120	121	122	74	75	76	77	78	78	79
5	50th	90	91	93	95	96	98	98	50	51	52	53	54	55	55
	90th	104	105	106	108	110	111	112	65	66	67	68	69	69	70
	95th	108	109	110	112	114	115	116	69	70	71	72	73	74	74
	99th	115	116	118	120	121	123	123	77	78	79	80	81	81	82
6	50th	91	92	94	96	98	99	100	53	53	54	55	56	57	57
	90th	105	106	108	110	111	113	113	68	68	69	70	71	72	72
	95th	109	110	112	114	115	117	117	72	72	73	74	75	76	76
	99th	116	117	119	121	123	124	125	80	80	81	82	83	84	84
7	50th	92	94	95	97	99	100	101	55	55	56	57	58	59	59
	90th	106	107	109	111	113	114	115	70	70	71	72	73	74	74
	95th	110	111	113	115	117	118	119	74	74	75	76	77	78	78
	99th	117	118	120	122	124	125	126	82	82	83	84	85	86	86
8	50th	94	95	97	99	100	102	102	56	57	58	59	60	60	61
	90th	107	109	110	112	114	115	116	71	72	72	73	74	75	76
	95th	111	112	114	116	118	119	120	75	76	77	78	79	79	80
	99th	119	120	122	123	125	127	127	83	84	85	86	87	87	88
9	50th	95	96	98	100	102	103	104	57	58	59	60	61	61	62
	90th	109	110	112	114	115	117	118	72	73	74	75	76	76	77
	95th	113	114	116	118	119	121	121	76	77	78	79	80	81	81
	99th	120	121	123	125	127	128	129	84	85	86	87	88	88	89
10	50th	97	98	100	102	103	105	106	58	59	60	61	61	62	63
	90th	111	112	114	115	117	119	119	73	73	74	75	76	77	78
	95th	115	116	117	119	121	122	123	77	78	79	80	81	81	82
	99th	122	123	125	127	128	130	130	85	86	86	88	88	89	90

Blood Pressure Levels for Boys by Age and Height Percentile (Continued)

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		← Percentile of Height →							← Percentile of Height →						
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11	50th	99	100	102	104	105	107	107	59	59	60	61	62	63	63
	90th	113	114	115	117	119	120	121	74	74	75	76	77	78	78
	95th	117	118	119	121	123	124	125	78	78	79	80	81	82	82
	99th	124	125	127	129	130	132	132	86	86	87	88	89	90	90
12	50th	101	102	104	106	108	109	110	59	60	61	62	63	63	64
	90th	115	116	118	120	121	123	123	74	75	75	76	77	78	79
	95th	119	120	122	123	125	127	127	78	79	80	81	82	82	83
	99th	126	127	129	131	133	134	135	86	87	88	89	90	90	91
13	50th	104	105	106	108	110	111	112	60	60	61	62	63	64	64
	90th	117	118	120	122	124	125	126	75	75	76	77	78	79	79
	95th	121	122	124	126	128	129	130	79	79	80	81	82	83	83
	99th	128	130	131	133	135	136	137	87	87	88	89	90	91	91
14	50th	106	107	109	111	113	114	115	60	61	62	63	64	65	65
	90th	120	121	123	125	126	128	128	75	76	77	78	79	79	80
	95th	124	125	127	128	130	132	132	80	80	81	82	83	84	84
	99th	131	132	134	136	138	139	140	87	88	89	90	91	92	92
15	50th	109	110	112	113	115	117	117	61	62	63	64	65	66	66
	90th	122	124	125	127	129	130	131	76	77	78	79	80	80	81
	95th	126	127	129	131	133	134	135	81	81	82	83	84	85	85
	99th	134	135	136	138	140	142	142	88	89	90	91	92	93	93
16	50th	111	112	114	116	118	119	120	63	63	64	65	66	67	67
	90th	125	126	128	130	131	133	134	78	78	79	80	81	82	82
	95th	129	130	132	134	135	137	137	82	83	83	84	85	86	87
	99th	136	137	139	141	143	144	145	90	90	91	92	93	94	94
17	50th	114	115	116	118	120	121	122	65	66	66	67	68	69	70
	90th	127	128	130	132	134	135	136	80	80	81	82	83	84	84
	95th	131	132	134	136	138	139	140	84	85	86	87	87	88	89
	99th	139	140	141	143	145	146	147	92	93	93	94	95	96	97

BP, blood pressure

* The 90th percentile is 1.28 SD, 95th percentile is 1.645 SD, and the 99th percentile is 2.326 SD over the mean.

For research purposes, the standard deviations in Appendix Table B–1 allow one to compute BP Z-scores and percentiles for boys with height percentiles given in Table 3 (i.e., the 5th,10th, 25th, 50th, 75th, 90th, and 95th percentiles). These height percentiles must be converted to height Z-scores given by (5% = -1.645; 10% = -1.28; 25% = -0.68; 50% = 0; 75% = 0.68; 90% = 1.28%; 95% = 1.645) and then computed according to the methodology in steps 2–4 described in Appendix B. For children with height percentiles other than these, follow steps 1–4 as described in Appendix B.

Blood Pressure Levels for Girls by Age and Height Percentile

Age (Year)	BP Percentile ↓	Systolic BP (mmHg)							Diastolic BP (mmHg)						
		← Percentile of Height →							← Percentile of Height →						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
1	50th	83	84	85	86	88	89	90	38	39	39	40	41	41	42
	90th	97	97	98	100	101	102	103	52	53	53	54	55	55	56
	95th	100	101	102	104	105	106	107	56	57	57	58	59	59	60
	99th	108	108	109	111	112	113	114	64	64	65	65	66	67	67
2	50th	85	85	87	88	89	91	91	43	44	44	45	46	46	47
	90th	98	99	100	101	103	104	105	57	58	58	59	60	61	61
	95th	102	103	104	105	107	108	109	61	62	62	63	64	65	65
	99th	109	110	111	112	114	115	116	69	69	70	70	71	72	72
3	50th	86	87	88	89	91	92	93	47	48	48	49	50	50	51
	90th	100	100	102	103	104	106	106	61	62	62	63	64	64	65
	95th	104	104	105	107	108	109	110	65	66	66	67	68	68	69
	99th	111	111	113	114	115	116	117	73	73	74	74	75	76	76
4	50th	88	88	90	91	92	94	94	50	50	51	52	52	53	54
	90th	101	102	103	104	106	107	108	64	64	65	66	67	67	68
	95th	105	106	107	108	110	111	112	68	68	69	70	71	71	72
	99th	112	113	114	115	117	118	119	76	76	76	77	78	79	79
5	50th	89	90	91	93	94	95	96	52	53	53	54	55	55	56
	90th	103	103	105	106	107	109	109	66	67	67	68	69	69	70
	95th	107	107	108	110	111	112	113	70	71	71	72	73	73	74
	99th	114	114	116	117	118	120	120	78	78	79	79	80	81	81
6	50th	91	92	93	94	96	97	98	54	54	55	56	56	57	58
	90th	104	105	106	108	109	110	111	68	68	69	70	70	71	72
	95th	108	109	110	111	113	114	115	72	72	73	74	74	75	76
	99th	115	116	117	119	120	121	122	80	80	80	81	82	83	83
7	50th	93	93	95	96	97	99	99	55	56	56	57	58	58	59
	90th	106	107	108	109	111	112	113	69	70	70	71	72	72	73
	95th	110	111	112	113	115	116	116	73	74	74	75	76	76	77
	99th	117	118	119	120	122	123	124	81	81	82	82	83	84	84
8	50th	95	95	96	98	99	100	101	57	57	57	58	59	60	60
	90th	108	109	110	111	113	114	114	71	71	71	72	73	74	74
	95th	112	112	114	115	116	118	118	75	75	75	76	77	78	78
	99th	119	120	121	122	123	125	125	82	82	83	83	84	85	86
9	50th	96	97	98	100	101	102	103	58	58	58	59	60	61	61
	90th	110	110	112	113	114	116	116	72	72	72	73	74	75	75
	95th	114	114	115	117	118	119	120	76	76	76	77	78	79	79
	99th	121	121	123	124	125	127	127	83	83	84	84	85	86	87
10	50th	98	99	100	102	103	104	105	59	59	59	60	61	62	62
	90th	112	112	114	115	116	118	118	73	73	73	74	75	76	76
	95th	116	116	117	119	120	121	122	77	77	77	78	79	80	80
	99th	123	123	125	126	127	129	129	84	84	85	86	86	87	88

Blood Pressure Levels for Girls by Age and Height Percentile (Continued)

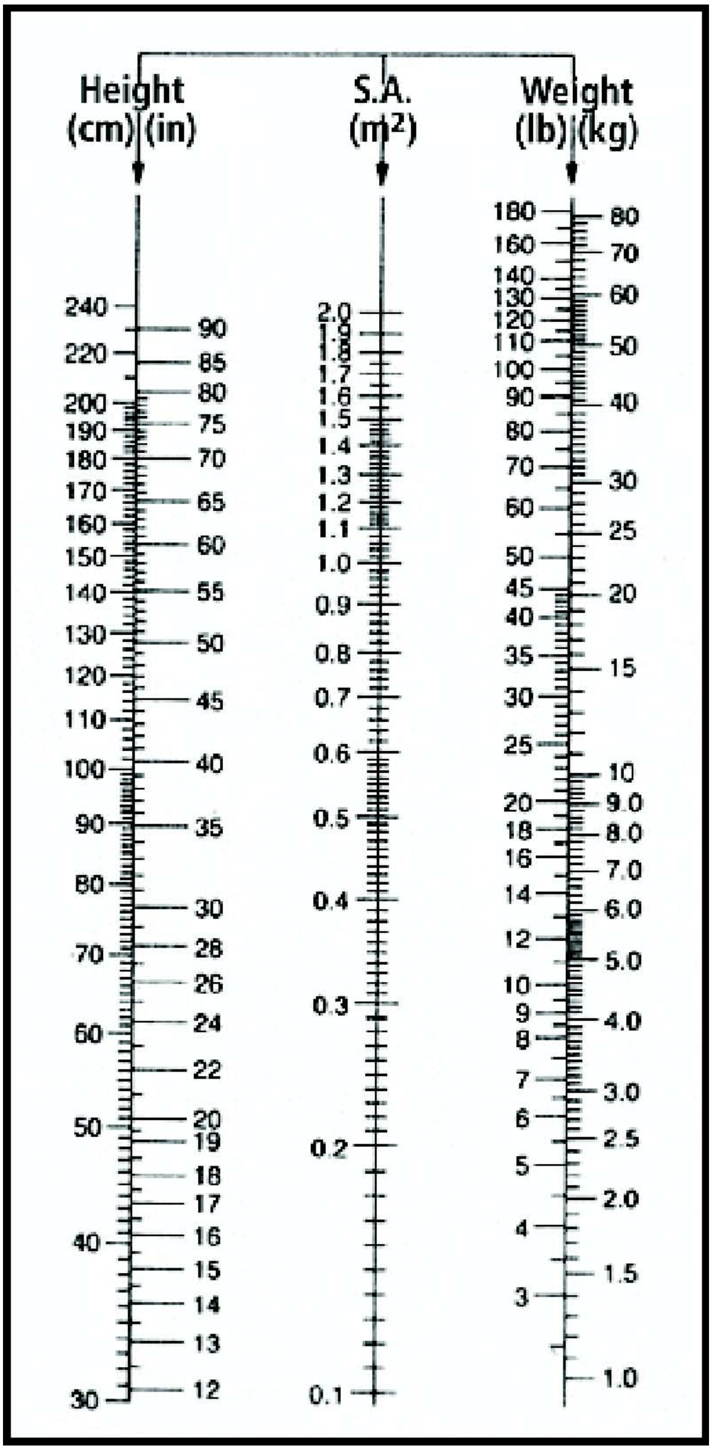
Age (Year)	BP Percentile ↓	Systolic BP (mmHg)							Diastolic BP (mmHg)						
		← Percentile of Height →							← Percentile of Height →						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
11	50th	100	101	102	103	105	106	107	60	60	60	61	62	63	63
	90th	114	114	116	117	118	119	120	74	74	74	75	76	77	77
	95th	118	118	119	121	122	123	124	78	78	78	79	80	81	81
	99th	125	125	126	128	129	130	131	85	85	86	87	87	88	89
12	50th	102	103	104	105	107	108	109	61	61	61	62	63	64	64
	90th	116	116	117	119	120	121	122	75	75	75	76	77	78	78
	95th	119	120	121	123	124	125	126	79	79	79	80	81	82	82
	99th	127	127	128	130	131	132	133	86	86	87	88	88	89	90
13	50th	104	105	106	107	109	110	110	62	62	62	63	64	65	65
	90th	117	118	119	121	122	123	124	76	76	76	77	78	79	79
	95th	121	122	123	124	126	127	128	80	80	80	81	82	83	83
	99th	128	129	130	132	133	134	135	87	87	88	89	89	90	91
14	50th	106	106	107	109	110	111	112	63	63	63	64	65	66	66
	90th	119	120	121	122	124	125	125	77	77	77	78	79	80	80
	95th	123	123	125	126	127	129	129	81	81	81	82	83	84	84
	99th	130	131	132	133	135	136	136	88	88	89	90	90	91	92
15	50th	107	108	109	110	111	113	113	64	64	64	65	66	67	67
	90th	120	121	122	123	125	126	127	78	78	78	79	80	81	81
	95th	124	125	126	127	129	130	131	82	82	82	83	84	85	85
	99th	131	132	133	134	136	137	138	89	89	90	91	91	92	93
16	50th	108	108	110	111	112	114	114	64	64	65	66	66	67	68
	90th	121	122	123	124	126	127	128	78	78	79	80	81	81	82
	95th	125	126	127	128	130	131	132	82	82	83	84	85	85	86
	99th	132	133	134	135	137	138	139	90	90	90	91	92	93	93
17	50th	108	109	110	111	113	114	115	64	65	65	66	67	67	68
	90th	122	122	123	125	126	127	128	78	79	79	80	81	81	82
	95th	125	126	127	129	130	131	132	82	83	83	84	85	85	86
	99th	133	133	134	136	137	138	139	90	90	91	91	92	93	93

BP, blood pressure

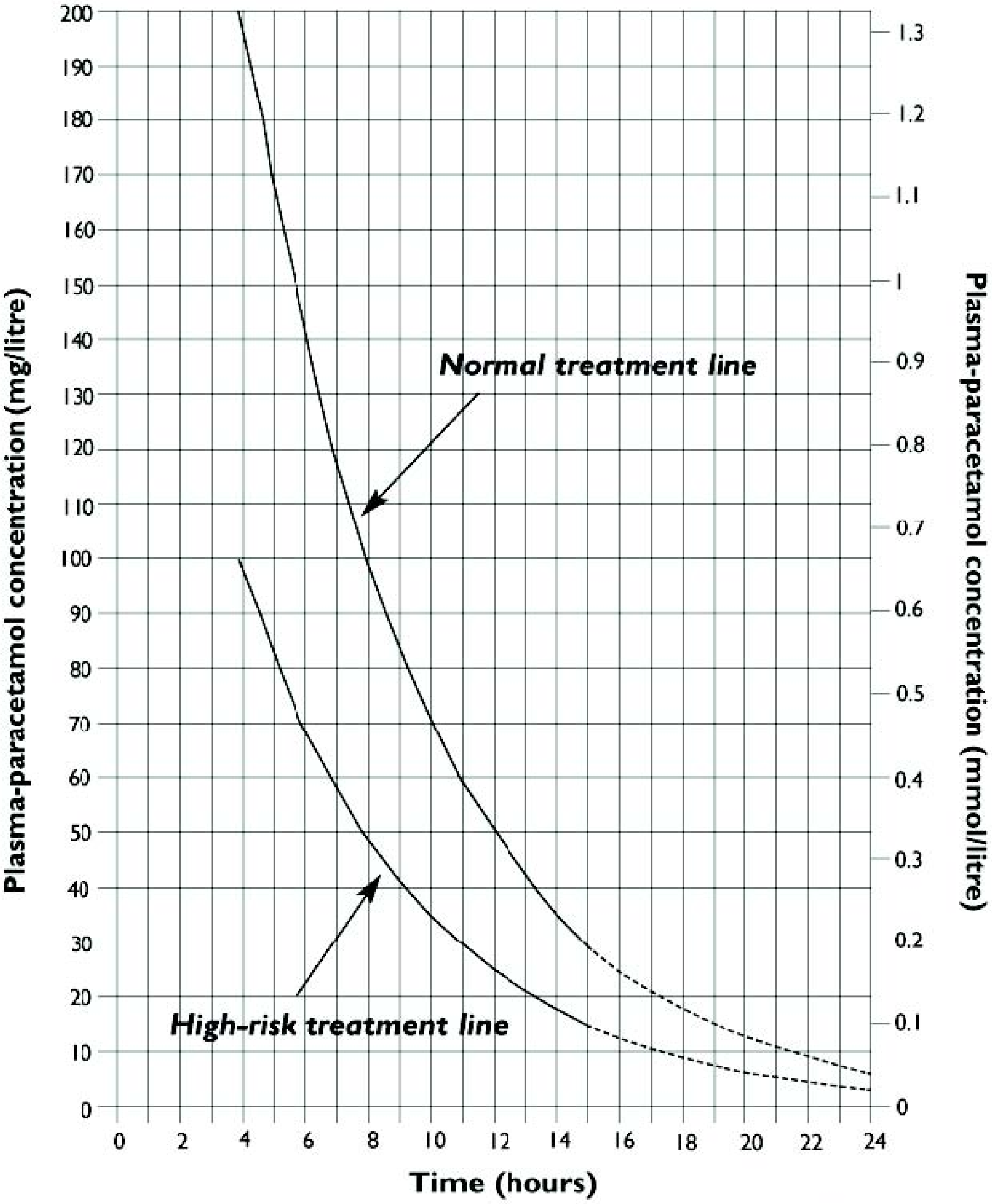
* The 90th percentile is 1.28 SD, 95th percentile is 1.645 SD, and the 99th percentile is 2.326 SD over the mean.

For research purposes, the standard deviations in Appendix Table B–1 allow one to compute BP Z-scores and percentiles for girls with height percentiles given in Table 4 (i.e., the 5th,10th, 25th, 50th, 75th, 90th, and 95th percentiles). These height percentiles must be converted to height Z-scores given by (5% = -1.645; 10% = -1.28; 25% = -0.68; 50% = 0; 75% = 0.68; 90% = 1.28%; 95% = 1.645) and then computed according to the methodology in steps 2–4 described in Appendix B. For children with height percentiles other than these, follow steps 1–4 as described in Appendix B.

Body Surface Area Nomogram



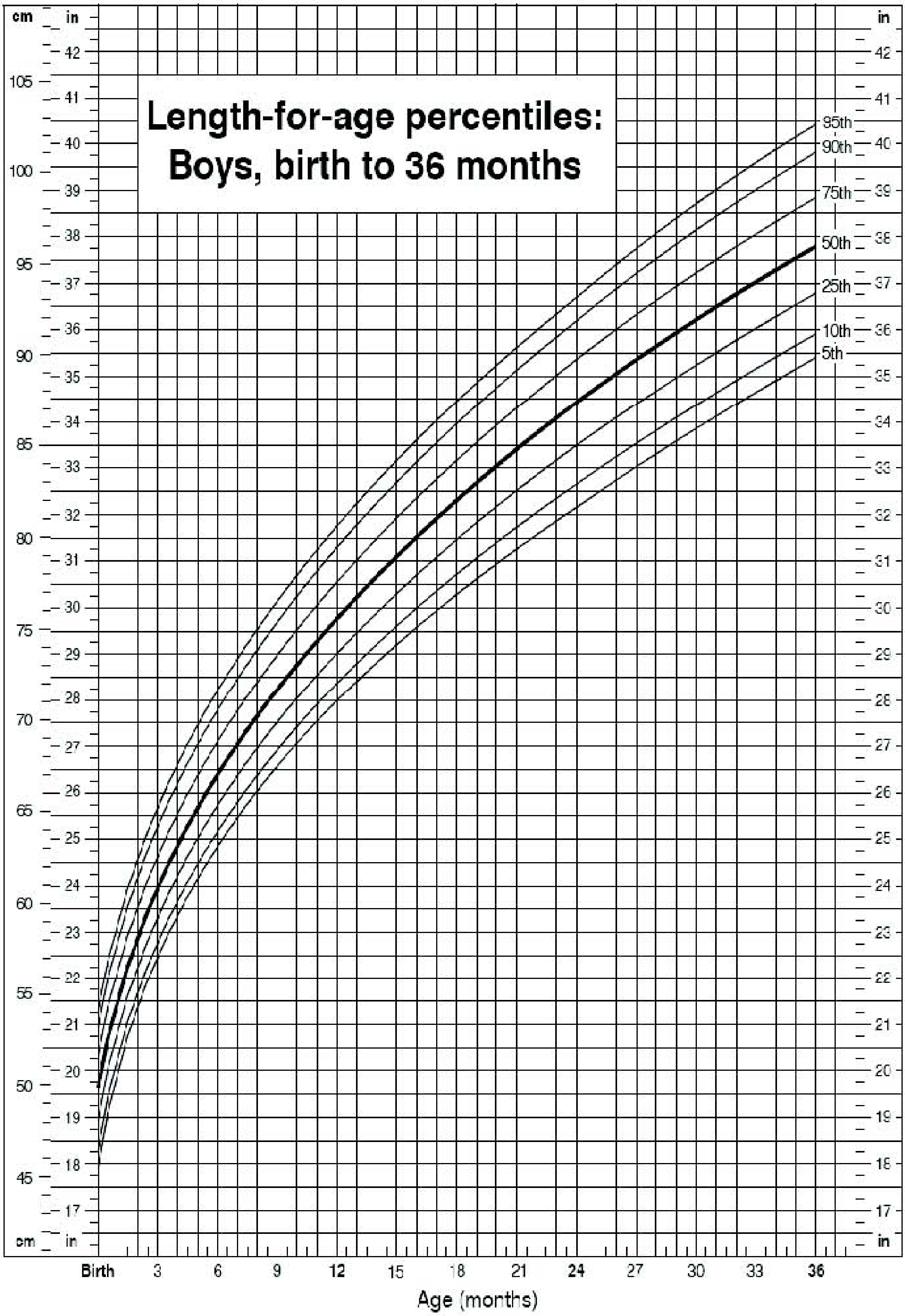
Nomogram for Paracetamol Poisoning



Patients whose plasma-paracetamol concentrations are above the **normal treatment line** should be treated with acetylcysteine by intravenous infusion (or, if acetylcysteine cannot be used, with methionine by mouth, provided the overdose has been taken **within 10–12 hours** and the patient is not vomiting).

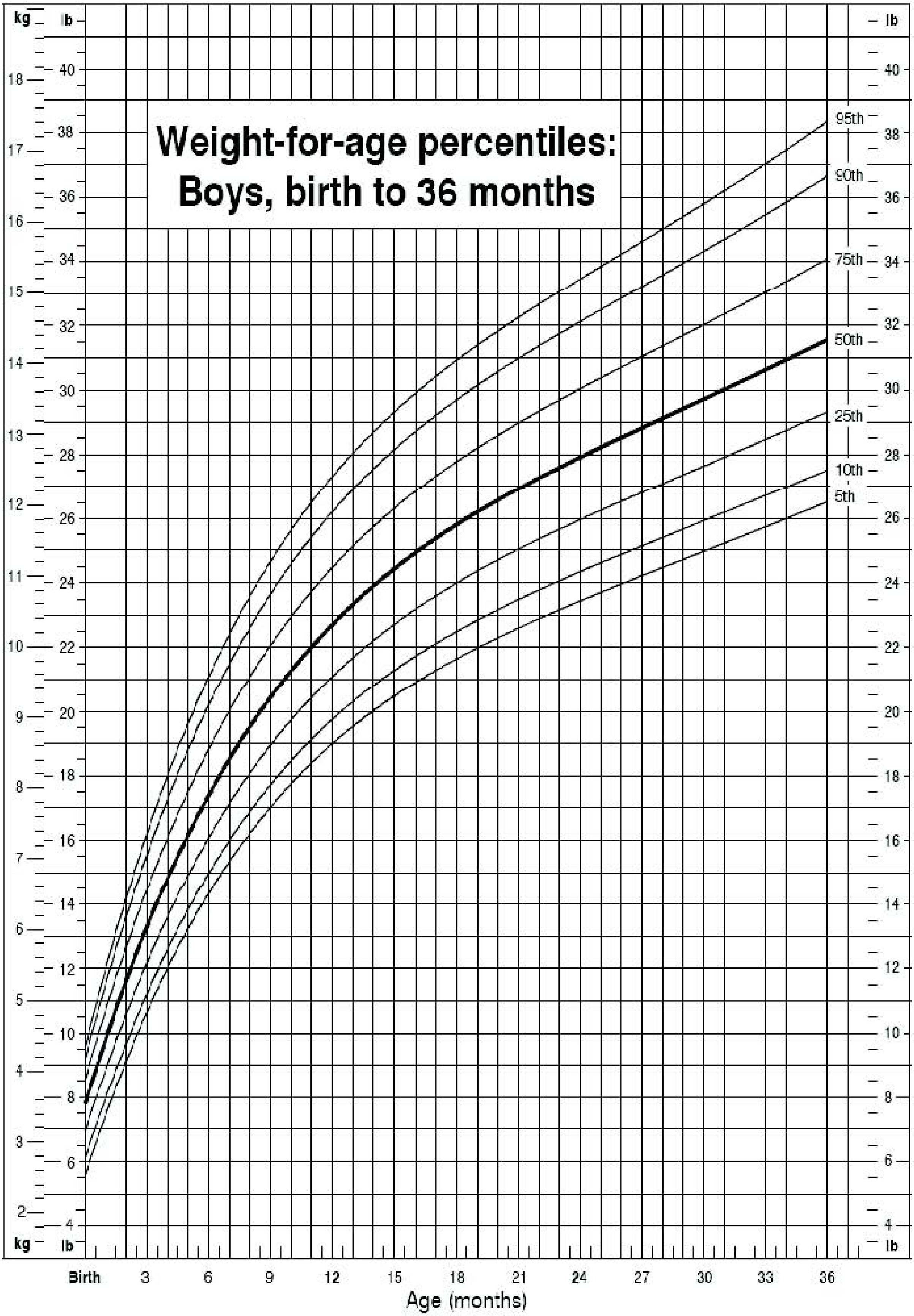
Patients on enzyme-inducing drugs (e.g. carbamazepine, phenobarbital, phenytoin, primidone, rifampicin, alcohol, and St John's wort), or who are malnourished (e.g. in anorexia, in alcoholism, or those who are HIV-positive), or underweight due to failure to thrive should be treated if their plasma-paracetamol concentration is above the **high-risk treatment line**.

The prognostic accuracy after 15 hours is uncertain but a plasma-paracetamol concentration above the relevant treatment line should be regarded as carrying a serious risk of liver damage.



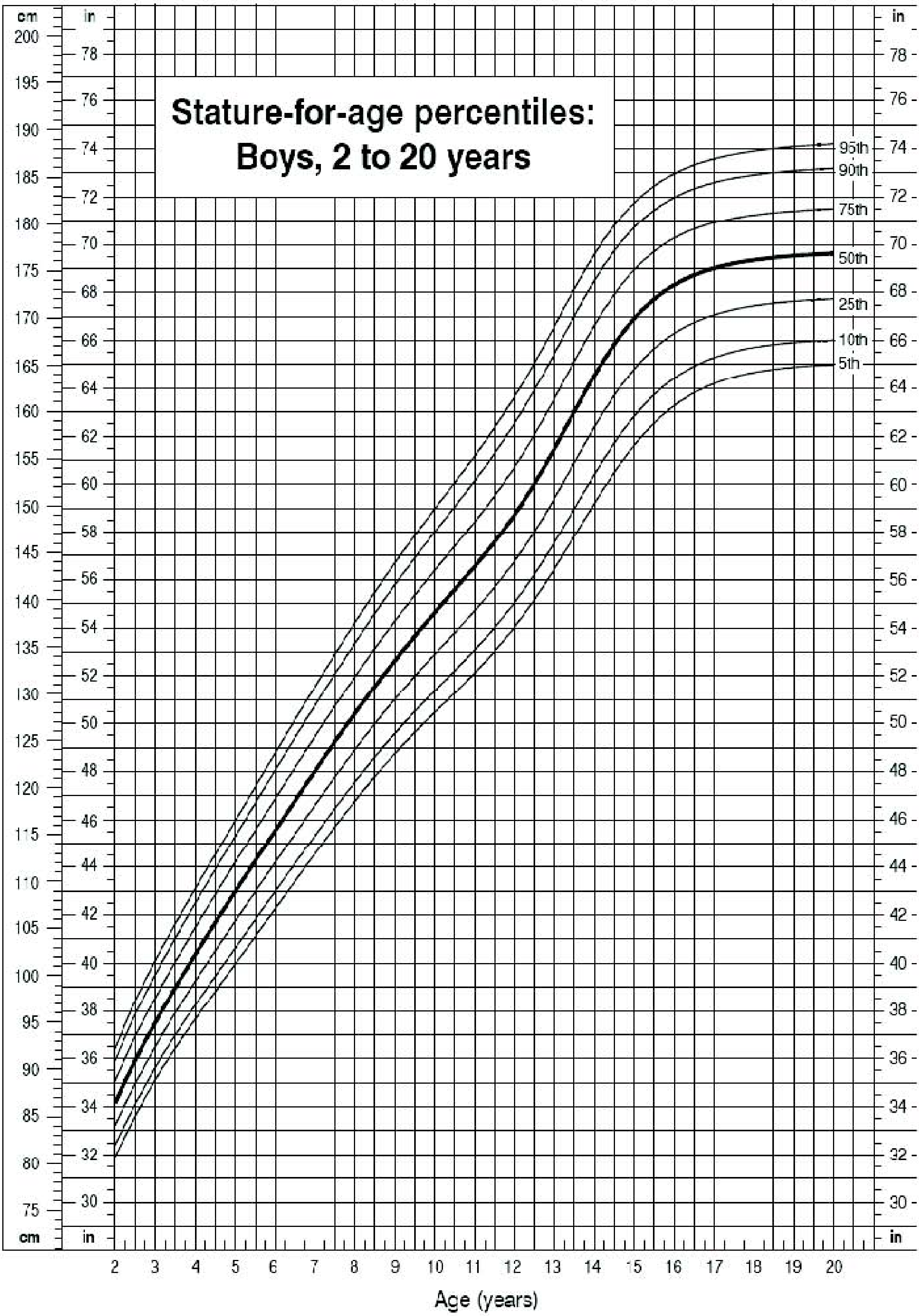
Length-for-age percentiles: Boys, birth to 36 months

SOURCE: Developed by the National Center for Health Statistics in collaboration with
the National Center for Chronic Disease Prevention and Health Promotion (2000)

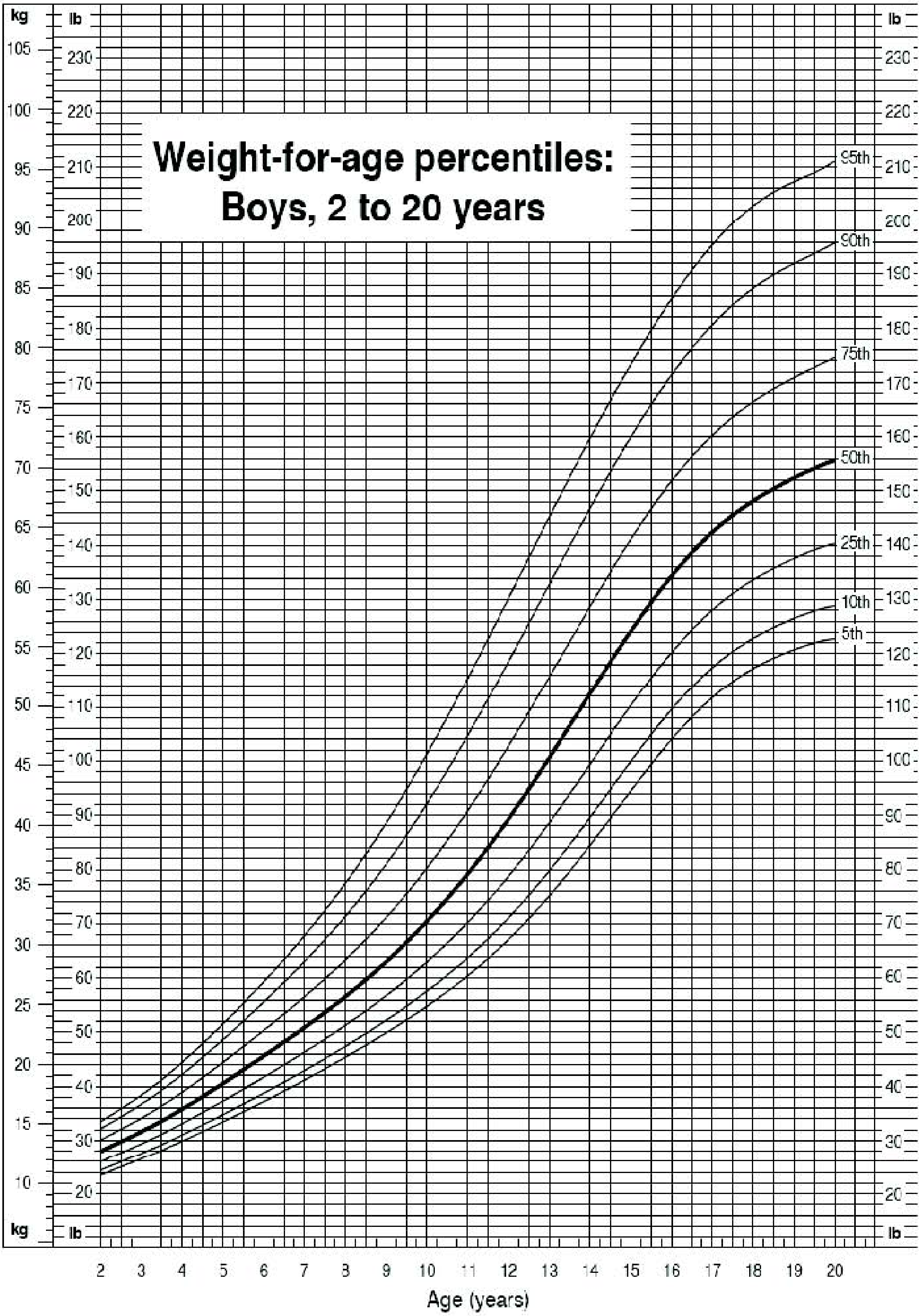


Weight-for-age percentiles: Boys, birth to 36 months

SOURCE: Developed by the National Center for Health Statistics in collaboration with
the National Center for Chronic Disease Prevention and Health Promotion (2000).

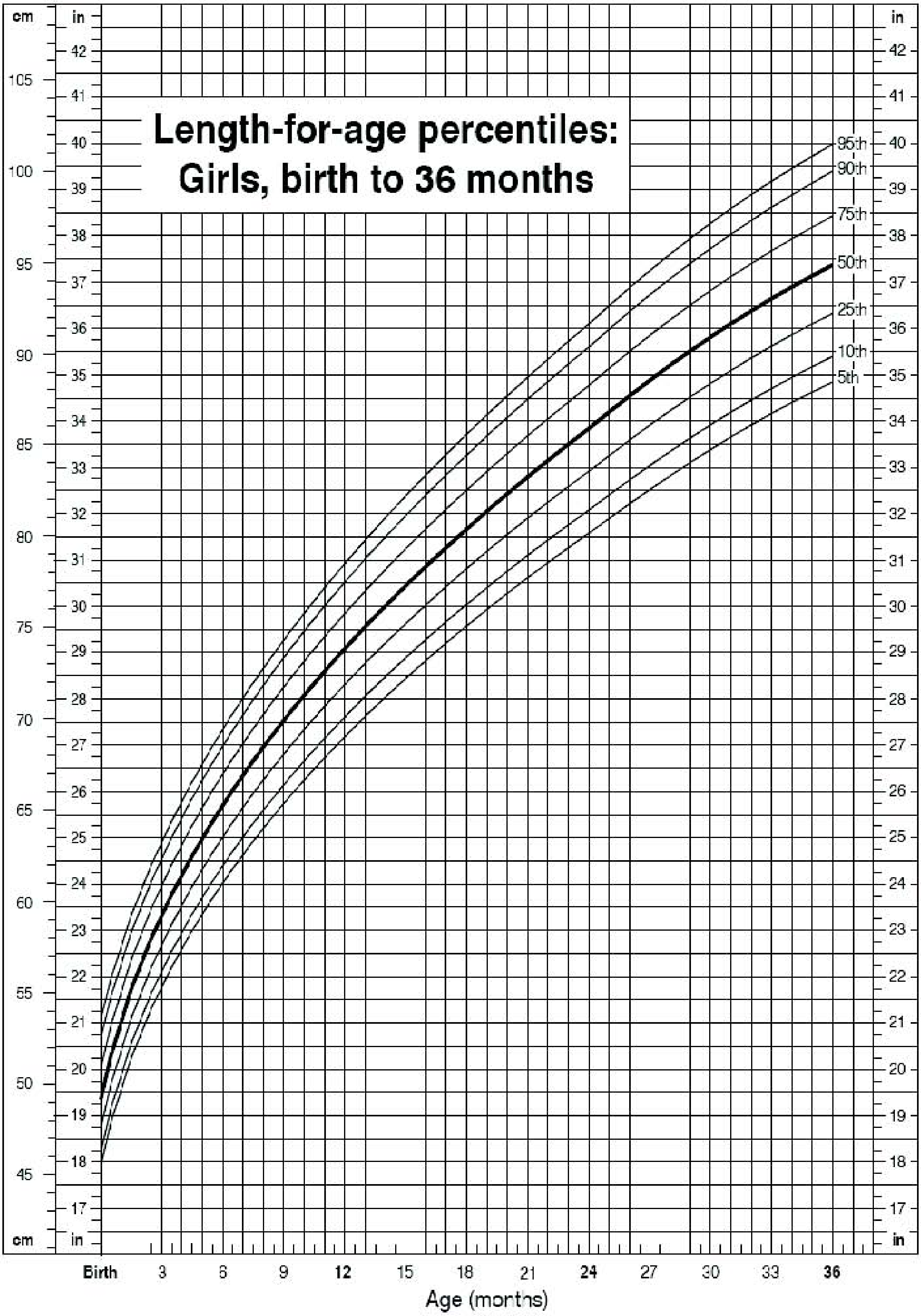


SOURCE: Developed by the National Center for Health Statistics in collaboration with
the National Center for Chronic Disease Prevention and Health Promotion (2000).



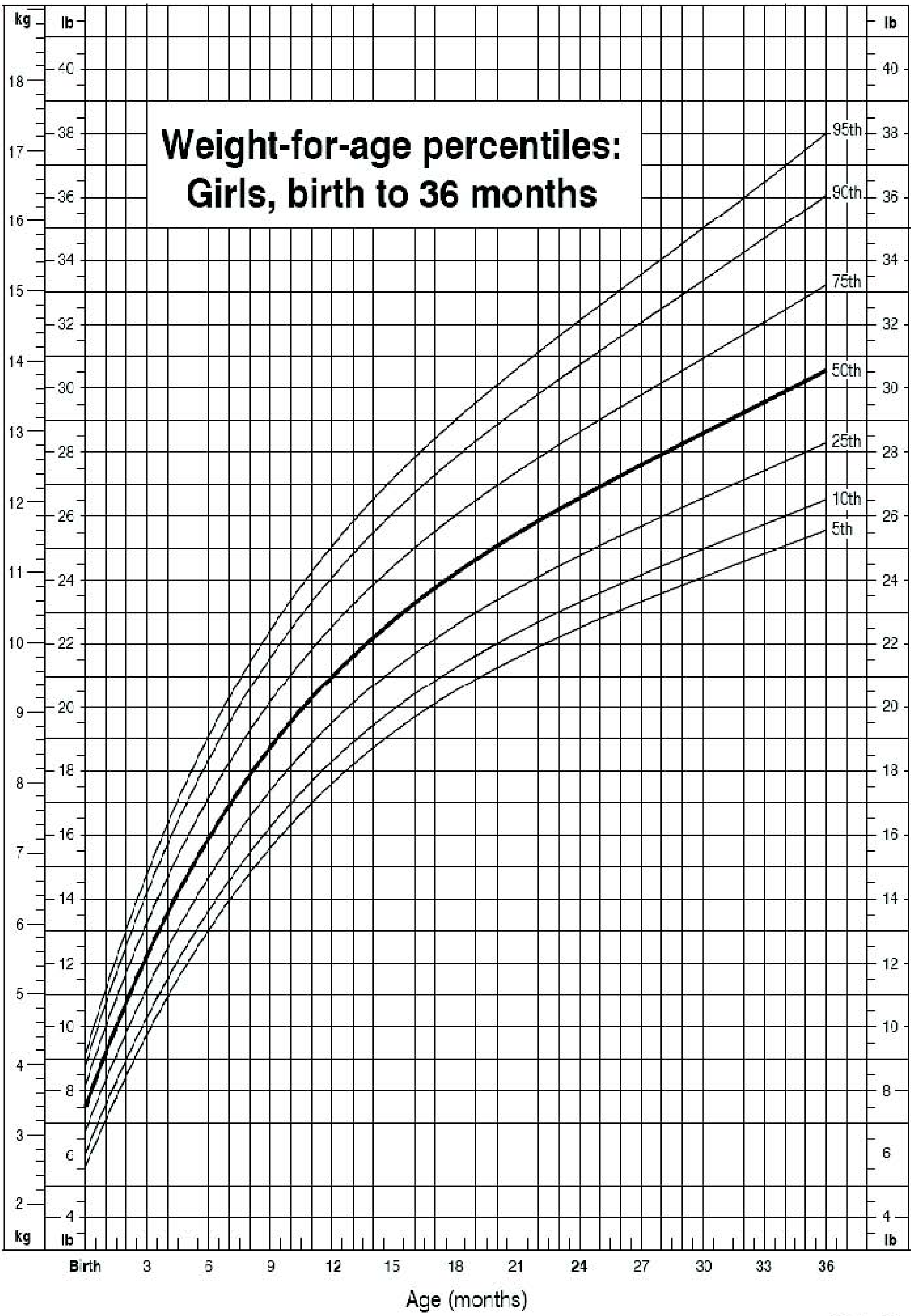
Weight-for-age percentiles: Boys, 2 to 20 years

SOURCE: Developed by the National Center for Health Statistics in collaboration with
the National Center for Chronic Disease Prevention and Health Promotion (2000).

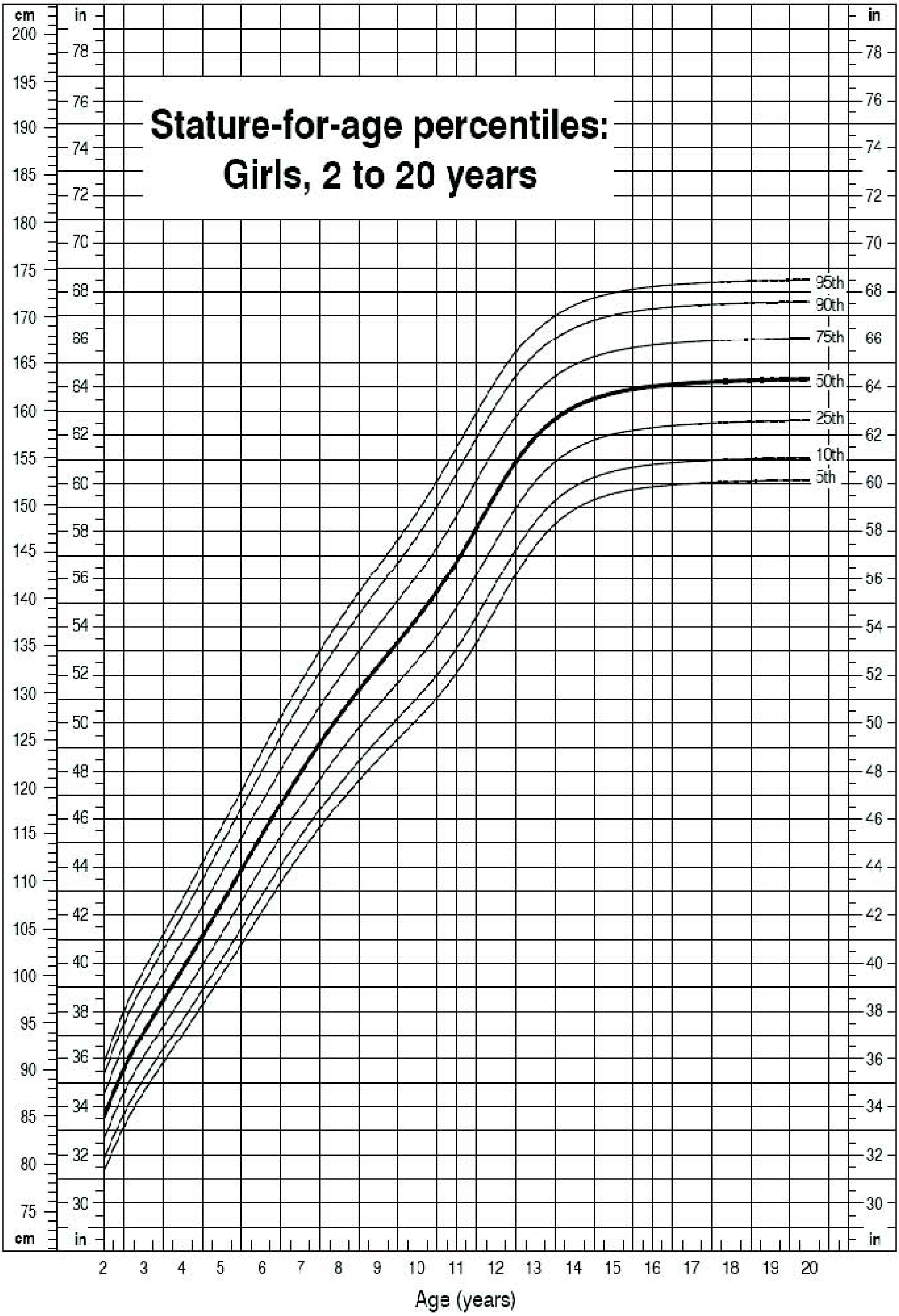


Length-for-age percentiles: Girls, birth to 36 months

SOURCE: Developed by the National Center for Health Statistics in collaboration with
the National Center for Chronic Disease Prevention and Health Promotion (2000).

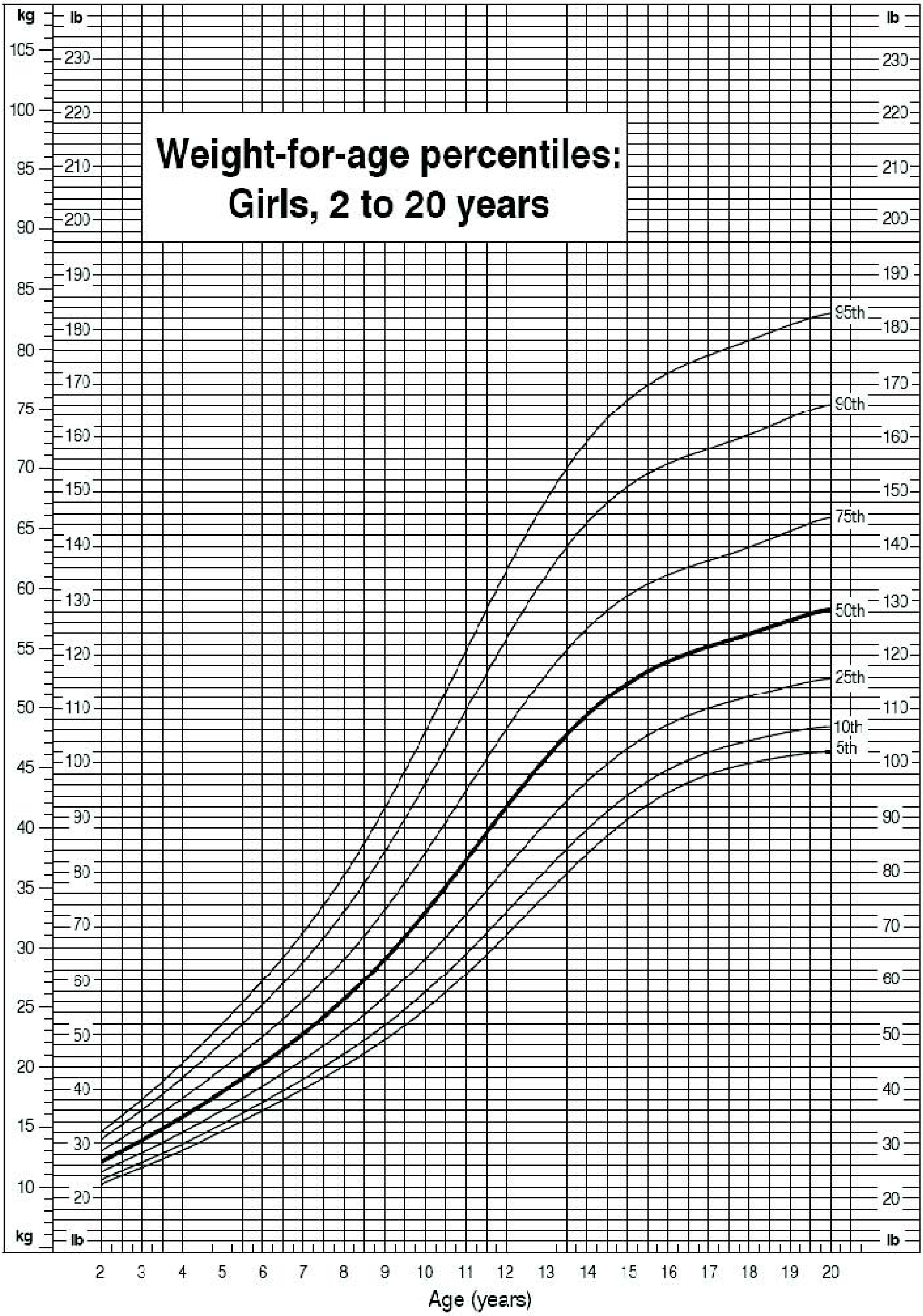


SOURCE: Developed by the National Center for Health Statistics in collaboration with
the National Center for Chronic Disease Prevention and Health Promotion (2000).



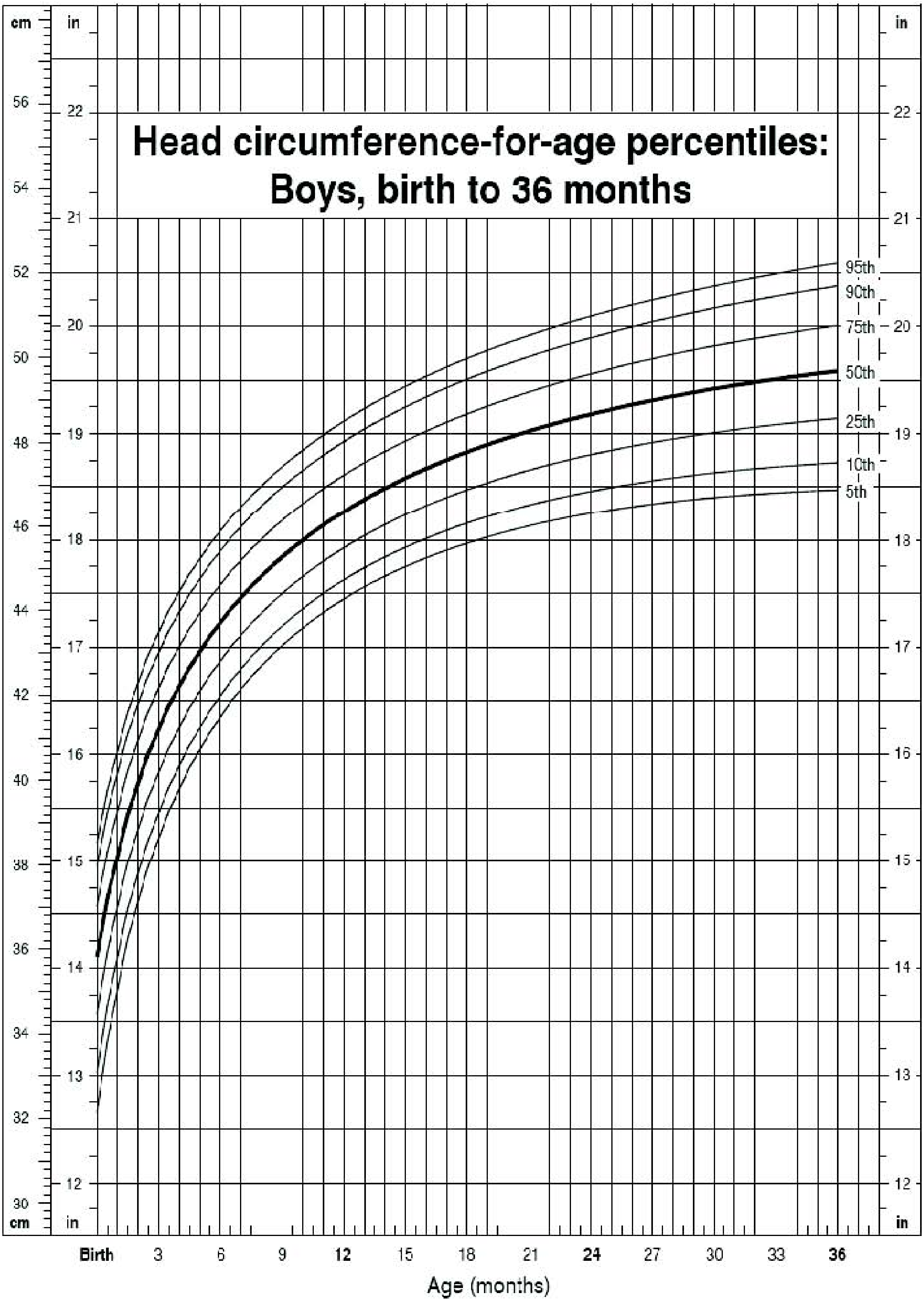
Stature-for-age percentiles:
Girls, 2 to 20 years

SOURCE: Developed by the National Center for Health Statistics in collaboration with
the National Center for Chronic Disease Prevention and Health Promotion (2000).



SOURCE: Developed by the National Center for Health Statistics in collaboration with
the National Center for Chronic Disease Prevention and Health Promotion (2000).

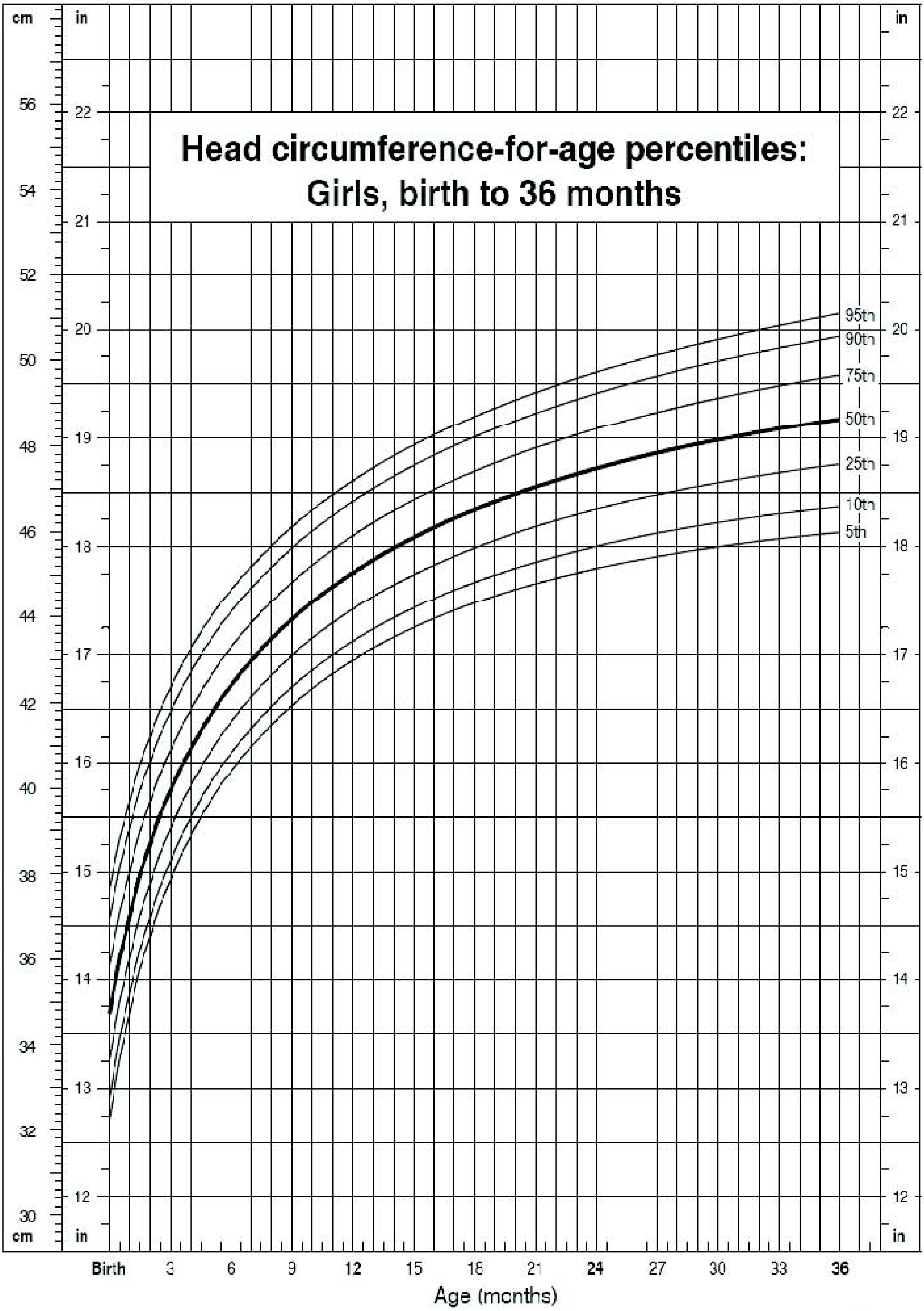
CDC



Head circumference-for-age percentiles: Boys, birth to 36 months

SOURCE: Developed by the National Center for Health Statistics in collaboration with
the National Center for Chronic Disease Prevention and Health Promotion (2000).

CDC



SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).